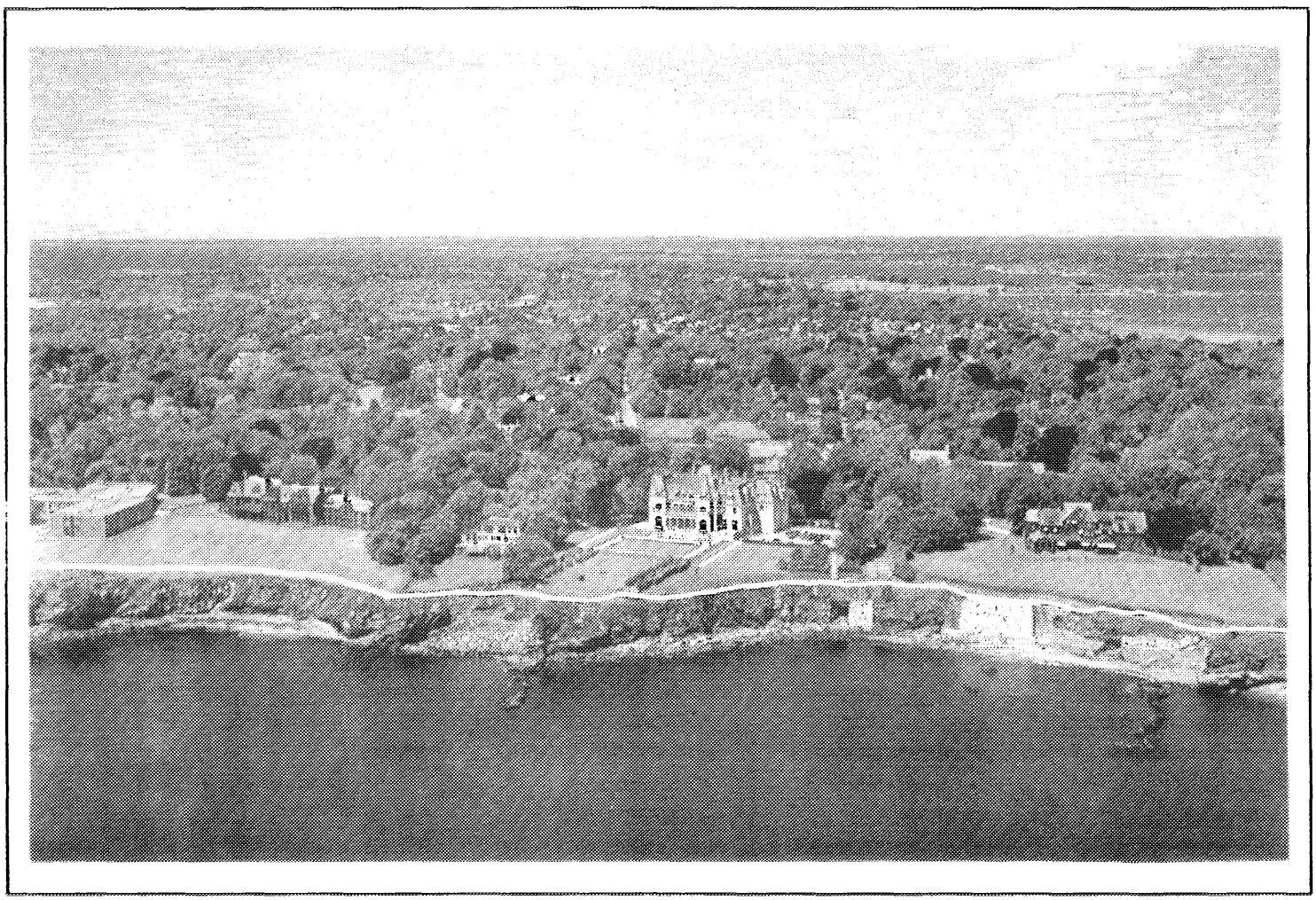
REPORT

HAZARD MITIGATION OPPORTUNITIES

for the

CLIFF WALK

Newport, Rhode Island



Federal Emergency Management Agency

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ACKNOWLEDGEMENTS

The principal authors of *Hazard Mitigation Opportunities for the Cliff Walk* are **Sarah James** and **William Hoffman**, members of the FEMA Cliff Walk Task Force.

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I. BACKGROUND AND PURPOSE OF REPORT

A. Purpose

The purpose of this report is to offer technical advice and information concerning preventative measures to combat future damage, physical deterioration, and threats to personal safety along the Cliff Walk in Newport, RI. The report is intended as a guide for present and future custodians of the Cliff Walk. The report discusses specific preventative measures such as the choice of vegetative coverings, type of soil stabilization methods, and drainage control, which may be appropriate for certain sections of the Cliff Walk. These measures also may prove useful for other coastal areas in need of erosion control and soil stabilization on steep slopes. The report does not provide site-specific design recommendations for particular damaged areas, nor does it recommend particular sites for hazard mitigation program funding. It does, however, contain some general landscape design guidance for treating damaged or eroded sections along the Cliff Walk and other well-traversed coastal paths.

B. History

On August 19, 1991, Hurricane Bob hit the coast of Rhode Island and southeastern Massachusetts. The hurricane caused significant wind and wave damage to coastal beach areas and damage to inland power lines and trees. Between August 26 and September 9, 1991, President Bush declared five New England states, including Rhode Island, to be national disaster areas. The presidential disaster declarations mobilized the Federal Emergency Management Agency (FEMA) to provide assistance to local and state government agencies in the affected areas.

Among the areas sustaining damage from Hurricane Bob was the Cliff Walk in Newport, RI. This historically and geologically significant trail is included in two historic districts of Newport listed on the National Register of Historic Places. It runs approximately three-and-a-half miles along the southeastern shoreline of Newport between the great mansions of Newport and the cliffs which form the shoreline. (See Map 1.) The Cliff Walk also was designated a National Recreation Trail by the Secretary of the Interior in August, 1975.

The Cliff Walk emerged as a cultural and recreational resource in the nineteenth century with the development of Newport as a resort area. The opportunity the Cliff Walk provides to view the great Newport mansions of the "Gilded Age" and the scenic vistas of ocean and cliffs has made it unique among the historical and cultural assets of the nation. It is estimated that 150,000 persons visit it each year.[1]

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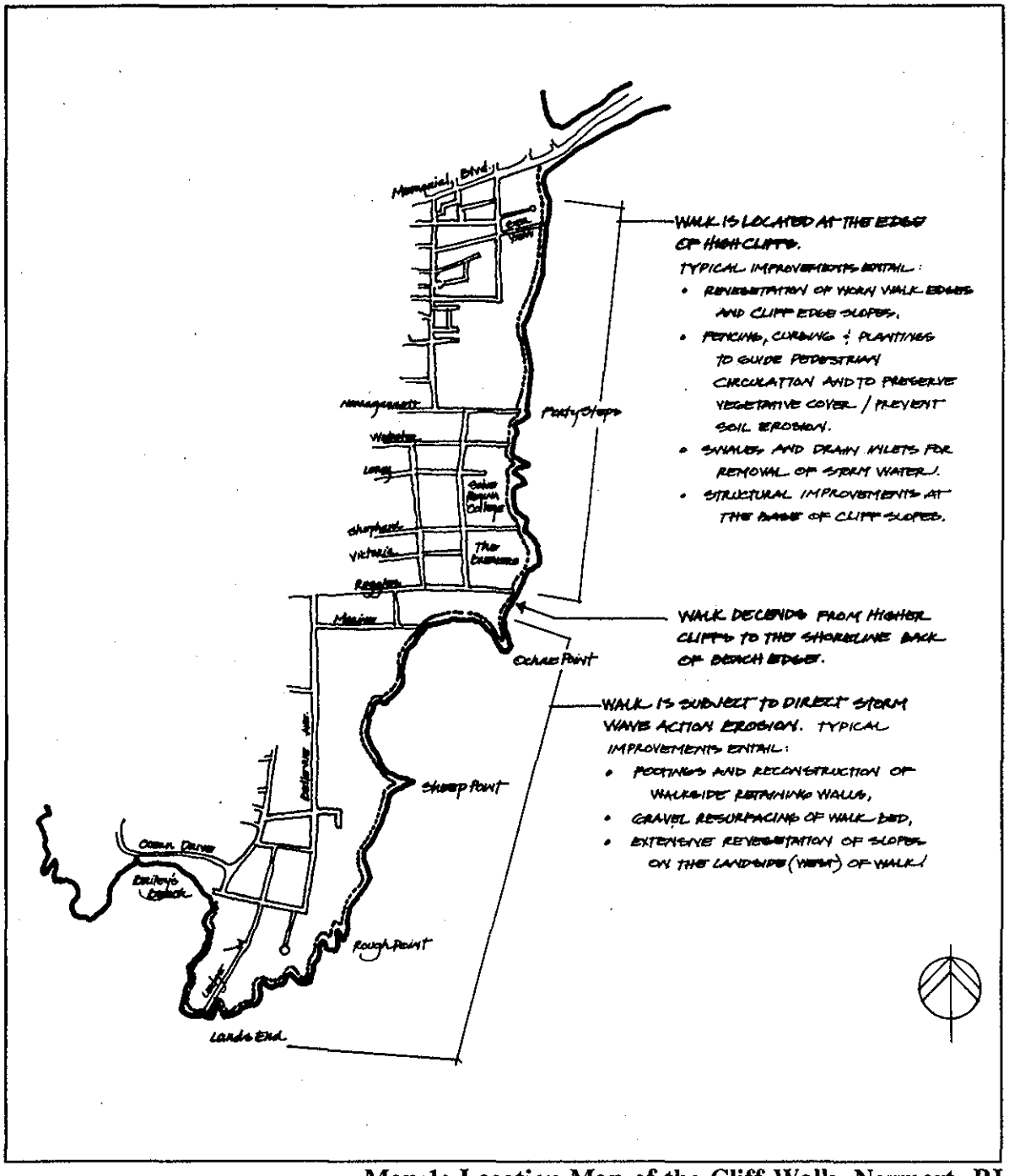
[1] Office of Planning & Design, North Atlantic Regional Office, National Park Service, *The Cliff Walk*, February 1989, p.1.



Map 1: Location Map of the Cliff Walk, Newport, RI

The Cliff Walk has a long, well-documented history of damage and continued deterioration from storm and wave action, as well as from ongoing storm water run off. Over time, various sections of the Cliff Walk have been shored up and structurally repaired by individual property owners, the Army Corps of Engineers, the City of Newport, and the State of Rhode Island. In 1964, the Army Corps of Engineers (ACOE) conducted a beach erosion control study of the Cliff Walk that documented existing damage to the Cliff Walk. This report identified the principal causes to be "wave action during storms accompanied by extremely high tides. Waves attack and erode unprotected glacial till bluffs and cliffs composed of soft rock. They cause erosion at the toes of existing structures with consequent undermining. In some places, wave run up causes overtopping of structures or low cliffs and washout of the Walk and bordering lawns. Some erosion also is caused by weathering and runoff of rainfall."[2]

In 1969, the ACOE completed design plans for repair of damaged sections of the Cliff Walk. The City of Newport passed bond issues for Cliff Walk repair in 1968 and 1970. The ACOE began repair work in 1971. The Corps completed additional studies of needed structural improvements in 1981 and again in 1988. Further repair work designed by the ACOE was carried out around 1985.

Other public and private initiatives concerning the Cliff Walk have included a 1989 National Park Service Study of the Cliff Walk,[3] requested by Congress, and nomination for status as both a National Park and a National Natural Landmark. In recent years, concerned private citizens have joined with local, state, and federal officials to form the Cliff Walk Task Force. The Task Force is studying management alternatives, maintenance options, repair needs, and property ownership options for the Cliff Walk.

A key challenge for the design of hazard mitigation opportunities as well as for the choice of management alternatives is the historic character of the Cliff Walk. According to the National Park Service study,[4] the right of public access along the cliffs can be traced to early colonial days when the Native Americans were granted a right-of-way to the sea for purposes of fishing and seaweed gathering. From the 1850s to the 1890s, as the great mansions were constructed along the shore, the Cliff Walk's popularity as a promenade grew. Several private landowners constructed structural improvements -- such as walls, stairs, and tunnels -- which served to delineate the Walk in many sections. The Walk became a local and regional attraction for tourists to admire the views of both the scenic cliffs and the stately mansions.

This report is intended largely as a resource document to aid the City of Newport, State of Rhode Island, and interested citizens' groups in the preservation and maintenance of the Walk as a safe and significant regional and national resource.

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[2] U.S. Army Corps of Engineers, *Beach Erosion Control Report on Cooperative Study of Cliff Walk, Newport, RI*, Waltham, MA, 6 March 1964, p.7.

[3] National Park Service, op. cit.

[4] Ibid.

C. FEMA's Overall Hazard Mitigation Objectives

A goal of the Federal Emergency Management Agency (FEMA) is to prevent or minimize future damage from natural disasters by carrying out preventative activities and programs in hazard mitigation. This goal was reinforced with the passage of the Robert T. Stafford Disaster Relief and Emergency Assistance Act in 1988 which established the Hazard Mitigation Grant Program. This program identifies, funds, and carries out mitigation measures identified in the post-disaster planning process.

Hazard mitigation activities can consist of one or more of four basic approaches, as follows:

1) **Land management**, which seeks to limit or prevent vulnerable development and populations in hazardous areas;

2) **Structural measures,** which identify and implement physical construction measures to shield people and development from harm;

3) **Hazard proofing**, which alters the physical design or construction of buildings and development to make it less vulnerable to hazards; and

4) **Emergency management**, which prepares for and responds to a natural disaster emergency in a manner which can reduce loss of life and property.[5]

In general, the hazard mitigation opportunities identified along the Cliff Walk combine the **structural measures** and **hazard proofing** approaches.

D. FEMA's Role in Hazard Mitigation Opportunities

Japanese Black Pine

The 1988 Stafford Act expanded FEMA's role in encouraging state and local governments to develop and maintain a systematic approach to identify hazards, monitor changes in hazard vulnerability, and implement measures to reduce vulnerabilities from natural disasters. Section 404 of the Act authorizes FEMA to make 50 percent matching grants to state and local governments and certain other eligible applicants for cost-effective hazard mitigation measures. State and local governments identify, set priorities for, and select appropriate, cost-effective projects for submission to FEMA. Since 404 funds may be limited according to the statutory formula set in the Stafford Act, the number and type of eligible 404 activities may exceed the 404 program funds available. Nevertheless, FEMA works to assist states and local governments in identifying potential opportunities for hazard

[5] Adapted from Federal Emergency Management Agency, *Making Mitigation Work: A Practical Handbook for State Officials*, Ralph M. Field Associates, Inc., Westport, CT, 1985, p.5.

mitigation. Research and guidance as to the range of implementation resources, including the 404 Program, is also provided.

The December 1991 Interagency Team Report on Hazard Mitigation identified six recommendations specific to the State of Rhode Island. **Recommendation RI6** states that "FEMA should provide technical assistance and guidance to the Cliff Walk Task Force" in addressing ongoing issues of safety and erosion that exist along the Cliff Walk. The discussion of specific opportunities for mitigating future damage to the Cliff Walk, which follow in the subject report, are in accordance with this recommendation.

E. Methodology: Identifying Hazard Mitigation Opportunities along the Cliff Walk

Following the August, 1991 hurricane, state and city officials requested FEMA disaster recovery assistance on behalf of the Cliff Walk. On September 9, 1991, FEMA Public Assistance and Hazard Mitigation staff, together with representatives from the City of Newport, conducted a preliminary damage assessment site visit to the Cliff Walk. Follow-up visits were made with state and city representatives throughout September and early October. These site visits were conducted primarily to identify and assess the damage to the Cliff Walk directly caused by Hurricane Bob. Costs associated with repair of damage from federally declared disasters are eligible for funding under the FEMA Public Assistance program.

During these site visits, particular opportunities for prevention of future damage and threats to life and safety were observed along the Cliff Walk. In some instances, these opportunities related to damage caused by Hurricane Bob. In other instances, the hazard mitigation opportunities were not directly related to Hurricane Bob. In either case, the observed sites were noted as potential opportunities for hazard mitigation. Further investigation and study of these sites, as well as research into possible mitigating measures to prevent future damage and life safety threats, has led to the development of this report.

F. Decisions for the City of Newport, State of Rhode Island and Cliff Walk Task Force

The Cliff Walk Task Force, comprised of private citizens, state, local, and federal officials, has been studying the Cliff Walk for some time to determine the most appropriate management alternative and to identify needed improvements and funding sources. Task Force members have also worked with FEMA concerning the damage caused by Hurricane Bob and repair of this damage. The Task Force is preparing its own plan for the Cliff Walk, as well as examining specific subjects such as property ownership issues and maintenance options.

Emerald Sea shore juniper

The City of Newport, with assistance from the State of Rhode Island and the Cliff Walk Task Force, will need to design and set priorities for a specific program of repairs, improvements, and ongoing maintenance of the Walk. Factors that should be considered in designing this program include the following:

- Personal safety
- Potential risk of future damage and deterioration to Walk
- Cost effectiveness
- Construction feasibility
- Appropriateness to historic character (materials, signage, design details)
- Aesthetics (plantings, edge treatment, preservation of views)
- Land use regulatory requirements and guidelines[6]

Section II of this report describes a series of measures relating to drainage management, erosion control, public safety and access control, which have been identified as key issues for preservation of the Cliff Walk. This information may prove helpful to those agencies and organizations involved in the repair and preservation of the Cliff Walk, as well as other coastal paths.

[6] For example, Rhode Island Coastal Resources Management Council permit requirements and Historic District guidelines.

II. GENERAL FINDINGS: OPPORTUNITIES FOR HAZARD MITIGATION ALONG THE CLIFF WALK

The damage to the Cliff Walk from Hurricane Bob and previous storms has threatened the integrity of some sections of the Walk and hence the Walk's function as a recreational, cultural, and geological community asset. Typical deterioration includes:

- Damage/destruction of structures, such as retaining walls
- Erosion of natural cliff escarpments
- Erosion of soil embankments from wave action
- Erosion of soil embankments from storm water runoff
- Damage/destruction of Walk surface
- Loss of stabilizing vegetation

Risks to the personal safety of pedestrians along the Cliff Walk are found primarily in areas where the Walk comes within a few feet of precipitous embankments or the cliffs. Undesignated access points from the Walk that pedestrians use to reach the cliffs or shoreline below may also be dangerous. Pedestrians also may face hazards in traversing areas of the path which have been damaged or destroyed by storm wave action, or in crossing naturally rocky areas such as Rough Point.

A. Overall Methods for Erosion Control

Erosion along the Cliff Walk has been caused both by ocean wave action and by storm water runoff. Two erosion control strategies that address this problem are:

- Structural armor stone and riprap with a graded bedding
- Soil stabilizing vegetation with or without stabilizing fabrics or mats

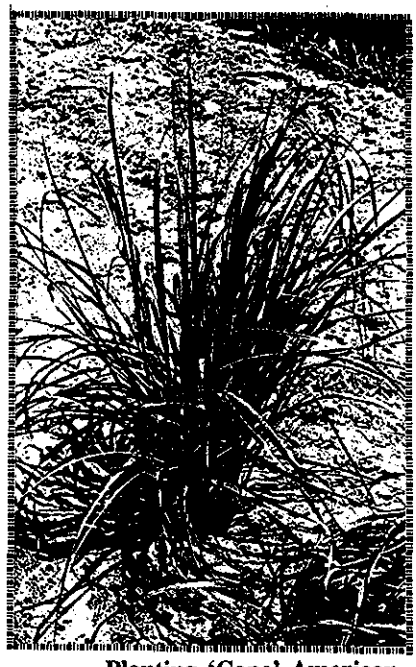
Stabilization of slopes through the use of soil-stabilizing vegetation and mats must be combined with structural options to ensure that water removal will not cause further erosion and soil loss. Drainage structures, necessary to guide storm water away without soil loss, include catch basins, drain inlets, ditches, and swales.

Pedestrian traffic along the Cliff Walk also contributes to soil erosion. The vegetative surface adjacent to the Walk must be protected from the wear and tear of foot traffic, which can result in weakened or destroyed plantings. Foot traffic can be controlled by:

- Dense, prickly vegetation
- Fencing
- Clearly designated and limited lookout areas
- Retaining and sitting walls at the perimeter of the Walk and lookout areas

These measures in turn can protect pedestrians from the precipitous cliffs along the Walk, and can limit pedestrian access to certain designated lookout and beach areas.

B. Use of Vegetation



Planting 'Cape' American beachgrass

Vegetation has several important uses for areas along the Cliff Walk:

- Erosion control and soil stabilization
- Public access control, guiding and limiting foot traffic
- Screening structures such as fencing or drainage swales
- Providing privacy for adjacent residences
- Providing animal habitat
- Enhancing the Walk's scenic quality

Varieties of plants and shrubs were investigated to provide a list of appropriate plantings for the variety of functions carried out by vegetation along the Cliff Walk. Considerations for the selection included the following:

1) Ground covers, characterized by rapid growth, medium height (which does not block scenic views), flowers, texture, salt tolerance, deep roots, winter appearance.

2) Grasses appropriate for lower slopes closer to direct wave action in erosion zone.

3) Broader selection of woody and herbaceous varieties appropriate for upper slopes. On the seaward side of Walk where eye-level views are desired, vegetation height should be 2-4 ft. Some trees could be placed strategically to frame views. On the landward side of the Walk, taller shrubs 3-4 ft. and 6-10 ft. can be used to frame selective views of the mansions, screen fencing, and provide interesting spaces along the Cliff Walk. Tree varieties can range from canopy trees to tall shrubs to evergreens that are salt tolerant.

The Plant List, following, presents some recommended species of plants that may be particularly appropriate for planting along the Cliff Walk. Recommended plants are grouped by types (A,B,C,D), which are noted on the conceptual design plans presented later in this report.

Planting Varieties Suggested for Revegetation

A. GRASSES/LEGUMES (Use for lower slopes closer to direct wave action in erosion zone.)

Tall Fescue	Festuca arundinacea
Cape American Beach Grass	Ammophilia breviligolata
Atlantic Coastal Panic Grass	Panicum amarun var. amarulum
Switch Grass	Panicum virgatum

Seed these on prepared soil, mix with tall fescue or perennial rye to provide temporary cover during germination.

B. SPREADING SHRUBS/VINES (Use along the seaward side of the Walk where preservation of views is desired as well as root stabilization of soils.)

Hall's Honeysuckle*	Lonicera japonica Halliana
Virginia Creeper*	Parthenocissus quinquifolia
Memorial Rose	Rosa wichuriana
Bearberry	Arctostaphylos uva-ursi
Spreading Junipers	Juniperus horizontalis
	Juniperus chinensis
Bittersweet	Celastris orbiculatus
Creeping Rugosa Rose	Rosa rugosa repens
Creeping Willow	Salix alba repens
Running Serviceberry	Amelanchier stolonifera

C. SHRUBS (Use outside the wave splash area where views and sight lines are not of primary importance.)

		Height
Virginia Rose	Rosa virginiana	4-6 ft.
Beach Rose	Rosa rugosa	4-6 ft.
Bayberry	Myrica pennsylvanica	3-9 ft.
Beach Plum	Prunus maritima	6 ft.
Arrowwood	Viburnum dentatum	14-15 ft.
Tatarian Honeysuckle	Lonicera tararica	6-10 ft.

Note: Soils should be limed (20-50#/1000 SF) and enriched with organic matter (1-2" worked into the top 4-6" of soil).

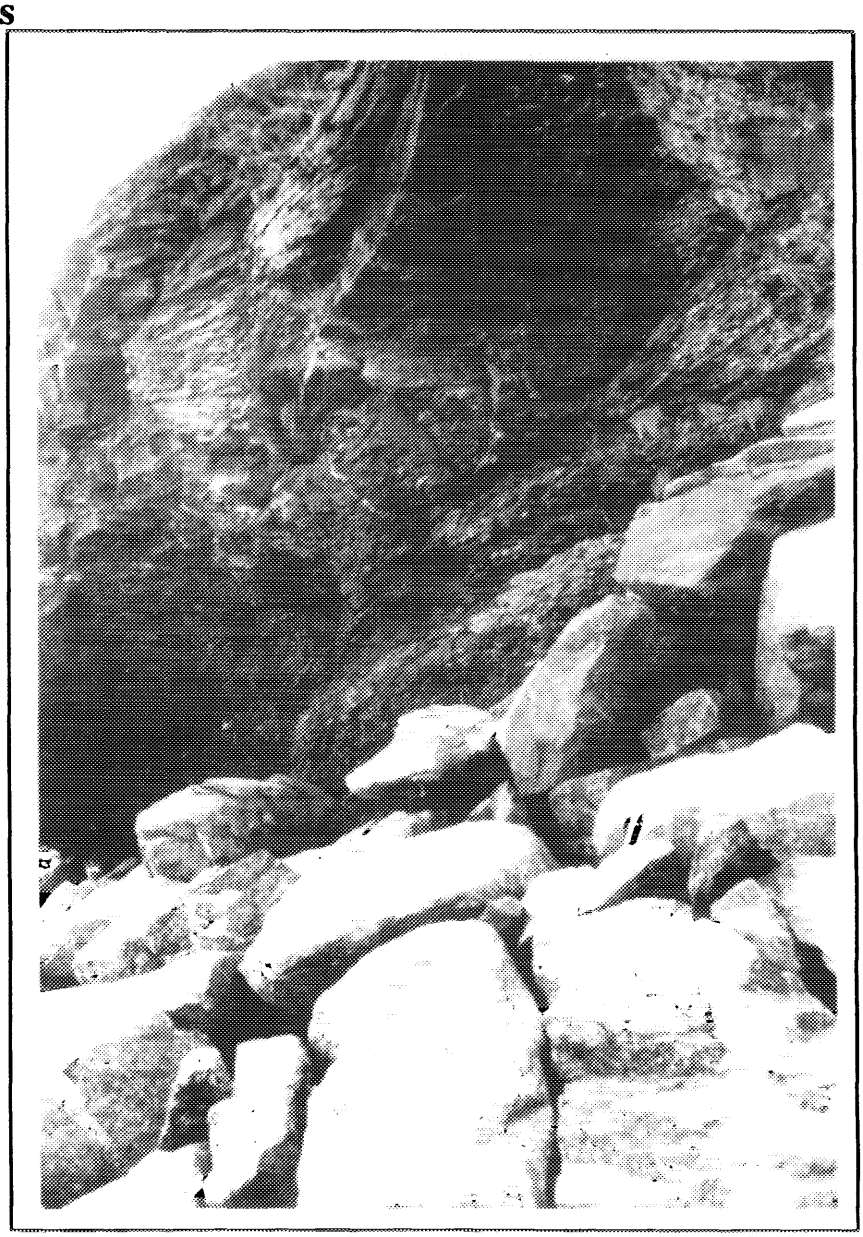
D. TREES (Use where views and sight lines are not of primary importance.)

		Height
Japanese Black Pine	Pinus thunbergii	20-40'
Austrian Pine	Pinus nigra	35-50'
Pitch Pine	Pinus rigida	40-60'
White Poplar	Populus alba	40-70'
Cockspur Thorn	Cratagus crus-galli	20-30'

* Best for screening fences

C. Structural Measures

Erosion of bluffs and cliffs along the Cliff Walk from storm wave action may necessitate stabilization measures beyond vegetation and soil stabilization. Sea walls, retaining walls, stone mounds, and revetments are types of structural measures appropriate for protection against storm wave action. Revetments made of large stone can be placed along the toes of cliffs or existing structural supports. Revetments can "dissipate wave attack, reduce erosion of soft rock cliffs, prevent undermining of existing structures, and reduce overtopping of structures or low cliffs. Stone mounds connecting projecting rocky points can act as breakwaters to protect small localized indented shore areas from further erosion. Beach fills and groins are not considered suitable protection of this area."[7]

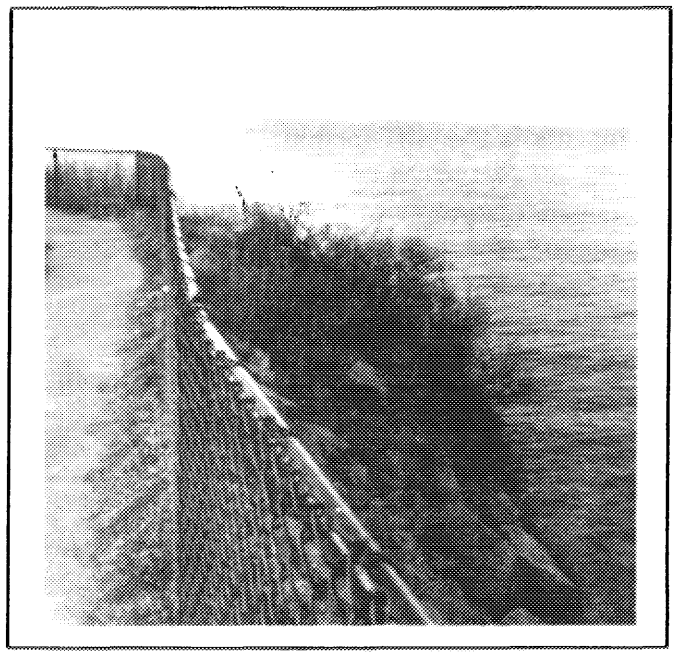


Site 10, View 1

In October, 1988, the Army Corps of Engineers (ACOE) completed a restudy report and general memorandum entitled *Shore Restoration and Protection for the Cliff Walk*. This report identifies specific sites along the Walk in need of structural repair and provides a recommended structural repair for each site. This information was referenced by FEMA Public Assistance staff in carrying out the damage assessment survey and in preparing subsequent damage survey reports for affected areas. Although the following paragraphs highlight a few sites particularly in need of structural attention, the reader is referred to the 1988 ACOE Report for a detailed and in-depth survey and analysis of structural repairs to the Walk.

[7] U.S. Army Corps of Engineers, op. cit.

Opportunities for Structural Repairs



Site 10, View 2

During September and October, 1991, FEMA staff, together with state and local officials, carried out an inspection and assessment of the damage to the Cliff Walk caused by Hurricane Bob in August, 1991. The purpose of the assessment was to identify the damage caused by Hurricane Bob that was potentially eligible for repair under the FEMA Public Assistance program. During this assessment process, it became evident that structural repairs to the Cliff Walk were needed beyond those directly caused by the August 1991 hurricane. It appeared that this damage had been caused by either previous storm and wave action, or by a lack of maintenance, or some combination of both. Although this pre-existing damage is not eligible for assistance through the FEMA Public Assistance program, it seems appropriate in this report to point out opportunities for repairs and corrections of conditions which, left unattended, could result in far more serious and costly structural damage to the Walk from future storms, wave action, and erosion. Several of these opportunities have already been pointed out in the 1988 Army Corps of Engineers Shore Restoration Plan for the Cliff Walk. More specific map locations are referenced in footnotes for location on the Corps maps provided in the Appendix.

First Priority

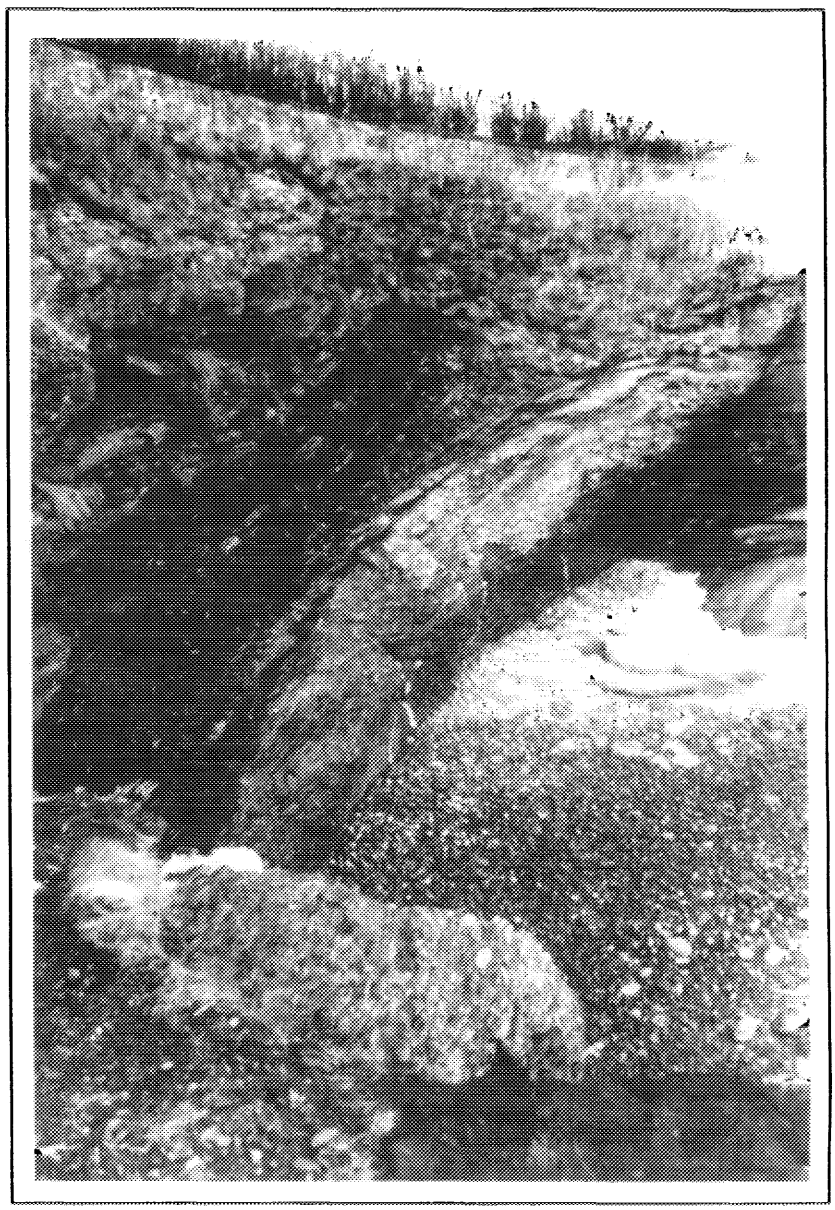
Site 10

This site, shown in Views #1 and #2 and Map 2[8] on the following page, was identified in the 1988 ACOE Report as needing an extension of the existing riprap revetment, and construction of a new concrete wall and fence. Erosion damage to the cliff outcrop shown in View #1 has been continual over time, rather than specifically caused by the August 1991 hurricane. The Walk is located within several feet of the top of this cliff outcrop. It also appears that this outcrop may have a fault line which renders it particularly susceptible to future storm damage. It is likely that future storms could lead to the collapse of this outcrop, threatening the integrity and safety of the Cliff Walk in this area. Accordingly, among the damaged sites ineligible for Public Assistance, this site appears to be of higher priority for attention.

Since the September 1991 site visit, the state of Rhode Island has installed safety fencing along the seaward side of the Cliff Walk directly above this damaged area.

[8] See also Map Plate 5, Reach 3 of 1988 ACOE Report in Appendix.

Site 7

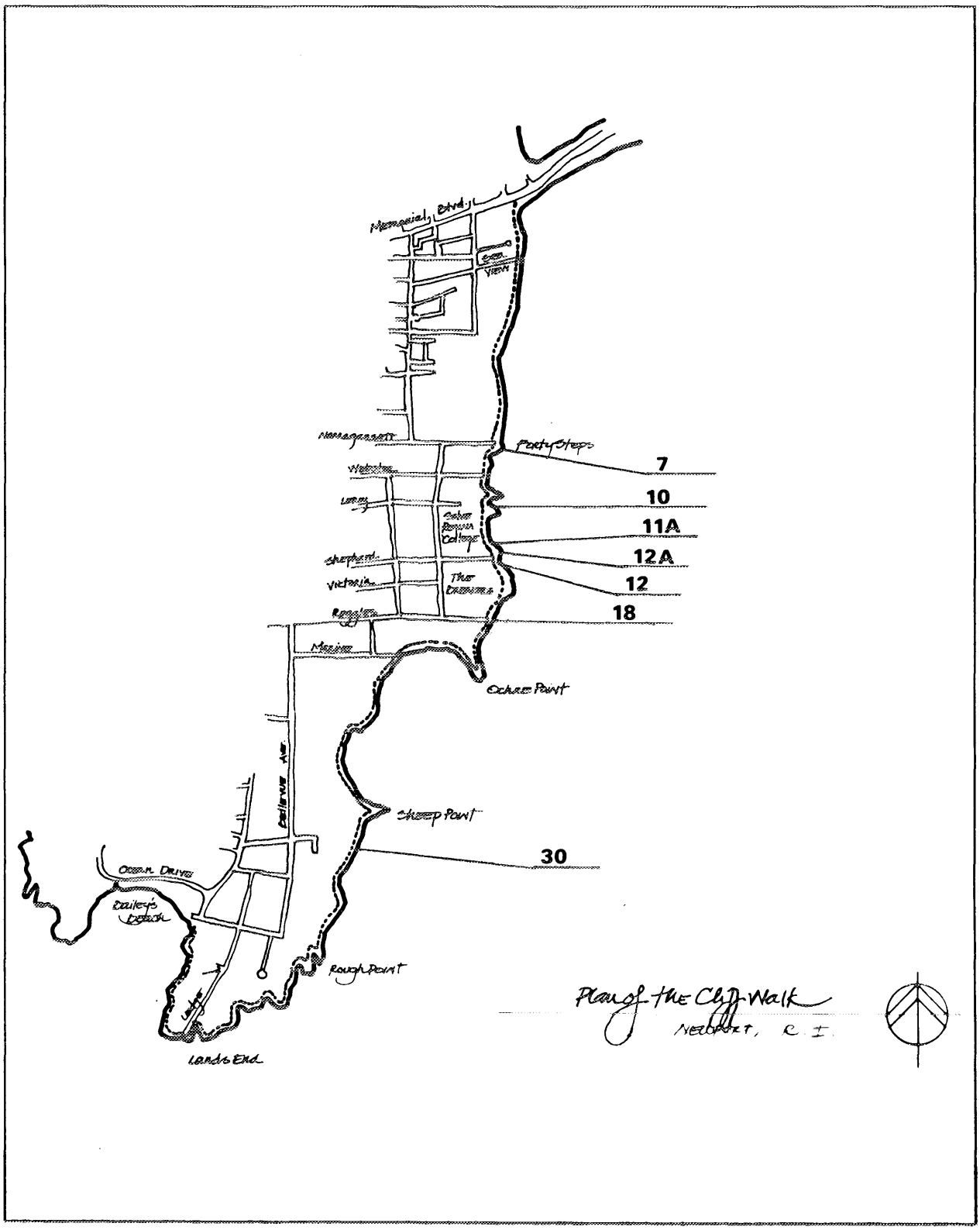


Site 7

This site is the cliff section about 80 feet south of the 40 Steps and Narragansett Avenue.[9] The 1988 ACOE Report identified this site as a critical area, stating that "the walk at this point is extremely narrow and is progressively eroding. Approximately three feet of material is all that is left from the edge of the walk to a vertical drop."[10] Although comparison of the 1988 ACOE photos with September 1991 photos reveals no substantial amount of additional erosion, this site remains a critical area as identified by the ACOE since the cliff edge is within a few feet of the Walk. The ACOE report recommended installation of a 10 ft. high by 20 ft. long retaining wall to prevent future erosion damage. It also appears that planting of vegetation above such a retaining wall is needed to stabilize the soil below the Walk. Safety fencing has been installed along the seaward side of the Walk above this area; hence there is no immediate threat to life safety at this point in time. Nevertheless, this site appears to remain as a higher priority for structural attention since the erosion is occurring within three feet of the path's edge.

[9] See Map ACOE Plate 12, Reach 2 of 1988 ACOE Report in Appendix.

[10] Army Corps of Engineers, *Shore Restoration & Protection Report for the Cliff Walk*, 1988, p.8.

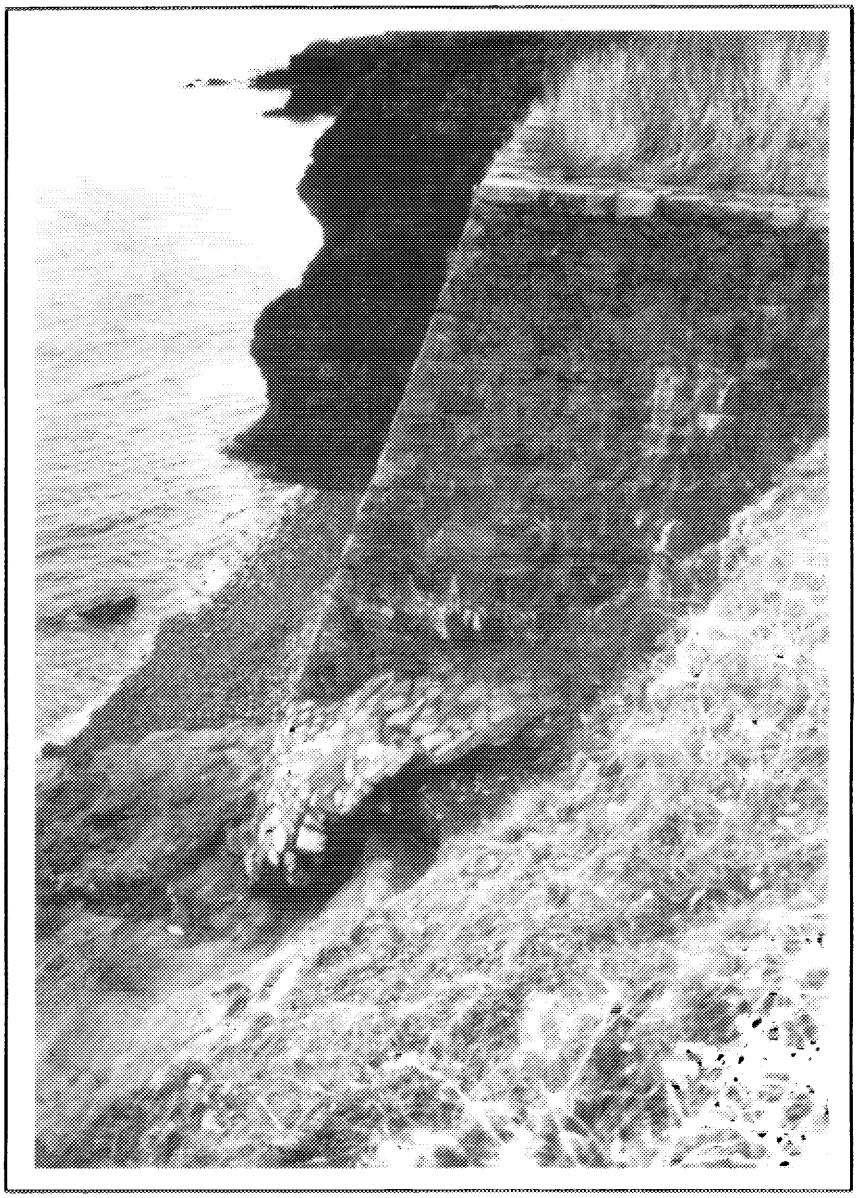


Map 2: Key Structural Repair Opportunities

Second Priority

Site 11a

Both the north and south ends of the existing stone retaining wall which constitutes this site are eroding adjacent to the embankment. The Cliff Walk comes within about 4-6 feet of the eroding south end of this wall. The 1988 ACOE Report recommended that this wall be repointed and repaired.[11] As an existing structure, where continued deterioration could result in both damage to the Walk and future costly repair, this site should be given priority for attention. A recent report by the City of Newport recommends fencing, vegetation and drainage improvements for this site.[12]



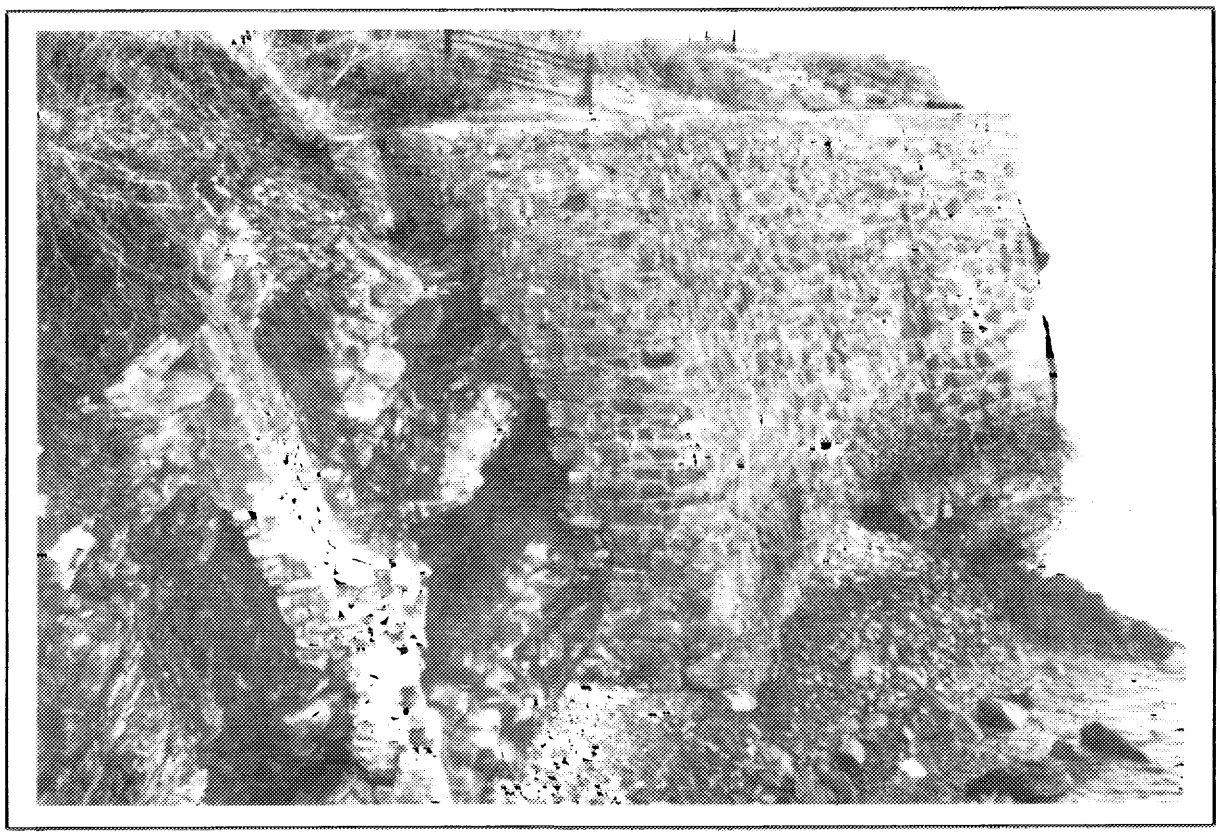
Site 11a

[11] See ACOE Plate 15, far left side, left wall marked for "Point and Patch Existing Walls."

[12] City of Newport Planning Department, "Preliminary Report on the Cliff Walk Restoration," 9 September 1991.

Site 12a

This site contains a stone masonry wall at the end of Shephard Avenue that was damaged prior to Hurricane Bob. Little damage has occurred to the wall since the 1988 ACOE Report. As in the case of Site #11a, this wall is a man-made structure which should be repaired and continually maintained. If left unattended, the potential damage and expense of repair is sure to increase. The City of Newport Report also recommends extending the proposed armor stone construction to further protect this area.[13]



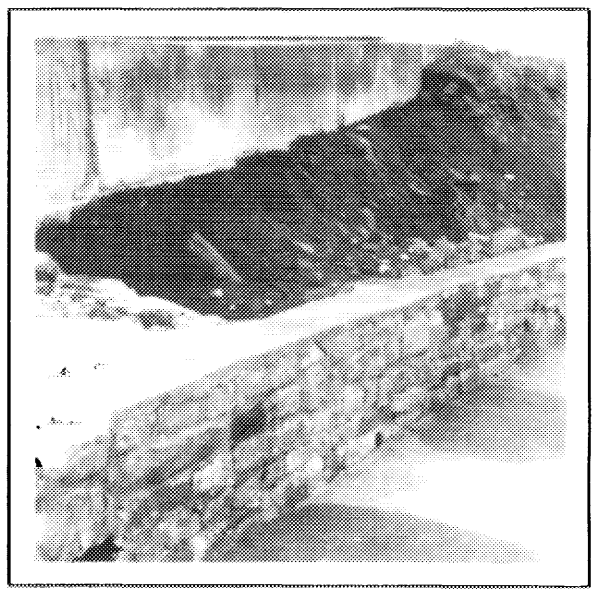
Site 12a

[13] City of Newport, op.cit.

D. Need for Ongoing Maintenance of the Cliff Walk

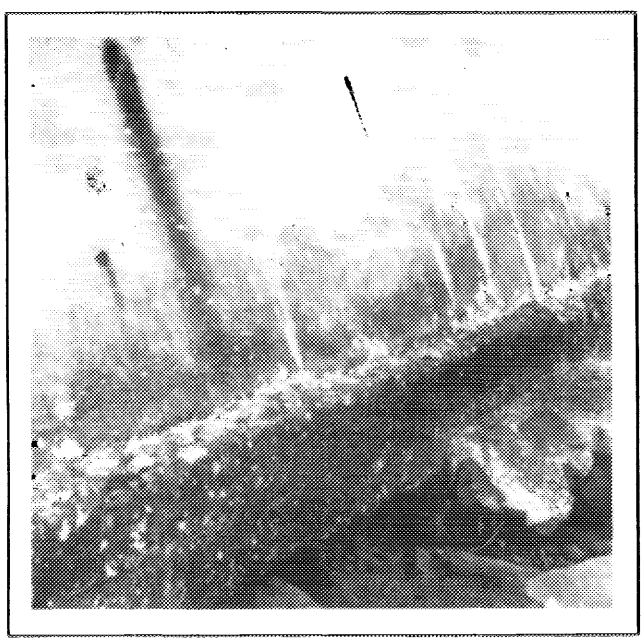
Some of the damage that has occurred on the Cliff Walk both from Hurricane Bob and prior storms could have been either avoided or lessened if structural and erosion control improvements had been maintained on a continuing basis.

Site 18, View 1



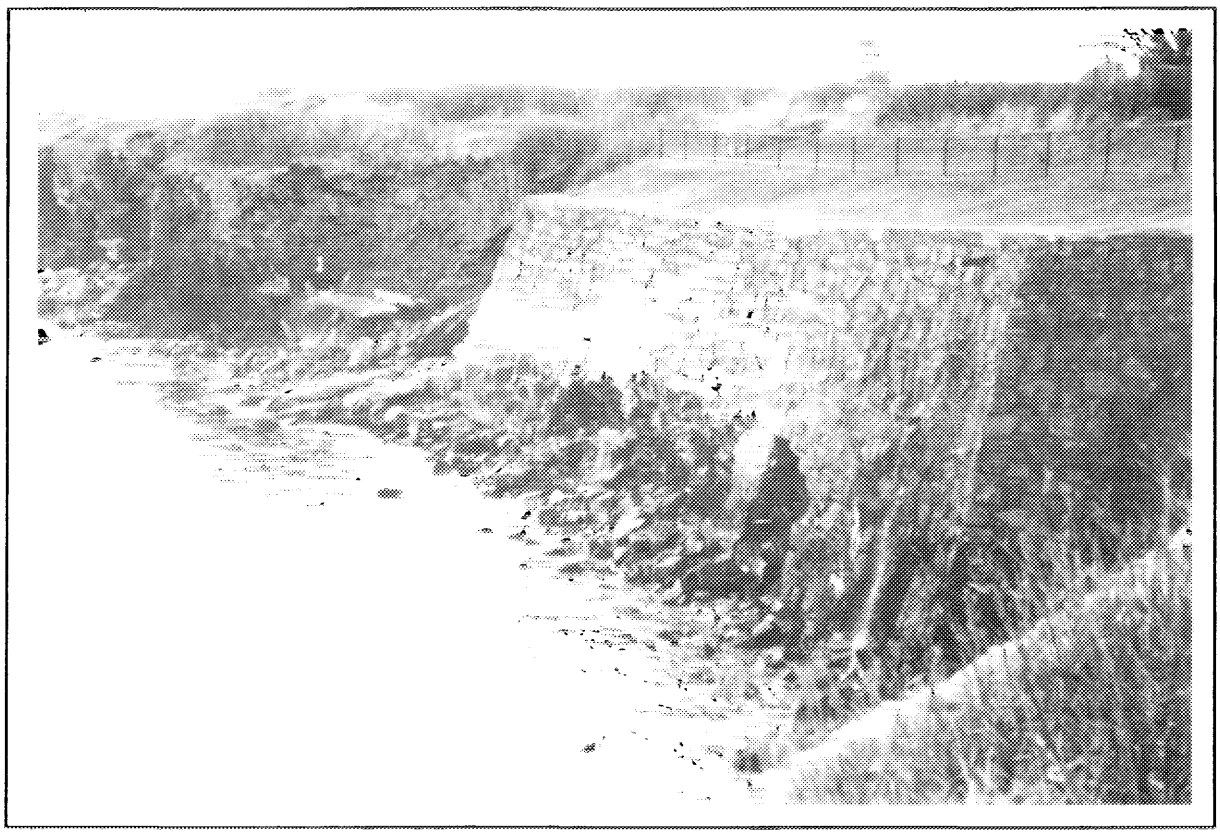
Site 18, View 2

One such example is Site 18. (See Views #1 and #2.) Here, failure to backfill the washed out areas behind the retaining wall allowed sea water and waves to undermine the ramp of the Cliff Walk and additional sections of the wall. In Site #30 (see photo below), unattended erosion damage to this concrete retaining wall has exposed the retaining wall footing.



Site 30

In Site #12, wave action from Hurricane Bob caused structural loss in three large eroded cavities of a major retaining wall that, were it to fail, could undermine almost 75 feet of the Walk.



Site 12

The development and implementation of an ongoing maintenance program for the Walk is probably the best hazard mitigation measure to guard against future storm damage. This is particularly important for the man-made structural improvements along the Cliff Walk. Such a program should include three components: 1) ongoing inspection and inventory of structural conditions; 2) ongoing repairs to or upgrading of damaged structural improvements; and 3) ongoing maintenance of stabilizing vegetation.

1. Inspection and Inventory

Inspection of structural conditions along the Cliff Walk should be conducted at regularly scheduled intervals and following large storms. Damage to structural improvements such as cracks, erosion, settlement, or wash out, should be inventoried, documented with photographs, and analyzed. A program to monitor damage should be initiated. Priorities for repairs can be established following a comparison evaluation of damage conditions.

2. Maintenance of Existing Structural Improvements

Structural, man-made improvements to the Walk should be continually repaired as damage occurs. Types of repairs could include:

a) Pointing and patching of stone or concrete walls
b) Backfilling of washout areas
c) Maintaining Walk surfaces - bituminous, concrete, and gravel
d) Cleaning filled catch basins and clogged drain lines
e) Maintaining drainage swales to clear debris and vegetation
f) Repairing damaged fencing
g) Managing drainage and surface run off
h) Removing woody plants and brush from riprap areas. These areas should also be checked for minor erosion and repaired where necessary.

3. Maintenance of Vegetation

As discussed earlier, vegetation plays an important part in stabilizing soils along the Cliff Walk and also in managing pedestrian circulation to and from the Walk. An ongoing plant maintenance program should include:

a) Soil replenishment, grading, and replanting of washed out vegetated areas;
b) Pruning and trimming along the Walk to maintain open swales, free-flowing catch basins, and also to preserve key scenic views; and
c) Maintaining a diverse plant community to ensure the survival of a vegetative cover if disease, drought, or salt water flooding should occur.

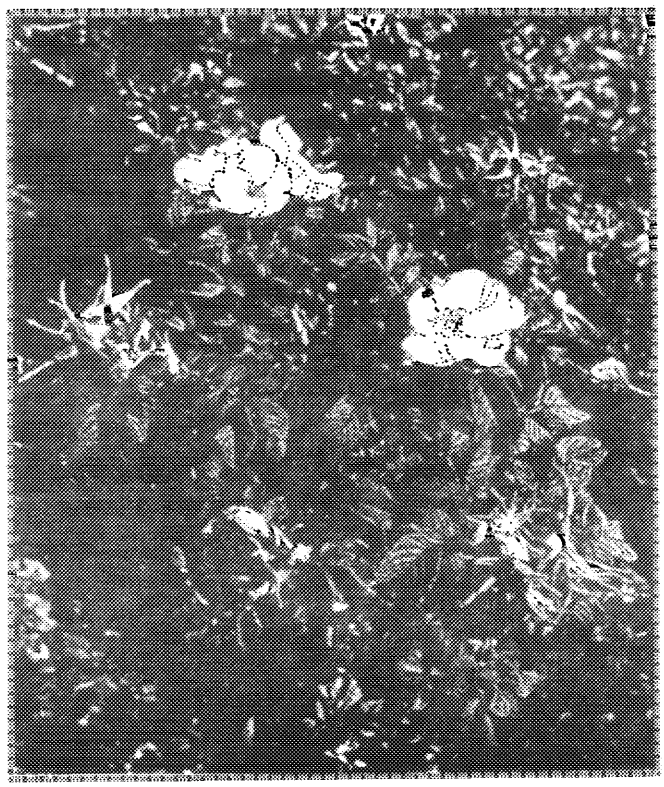
Carried out in a timely manner, these repairs are not necessarily costly. The expense of totally rebuilding facilities that could have been saved by proper maintenance would be far more costly.

III. DESIGN SUGGESTIONS FOR NON-STRUCTURAL EROSION CONTROL AND SAFETY MEASURES ON THE CLIFF WALK

Essential hazard mitigation issues to consider when designing solutions to prevent future damage to the Walk are:

- Control of erosion from both wave action and storm water runoff
- Implementation of measures to ensure the safety of the general public

The following is a series of conceptual design details which suggest improvements for managing erosion and public safety. They are intended as models for addressing these problems as they occur along the Walk and cliffs.



Rugosa rose

Sketch 1: A Typical Section of the Cliff Walk

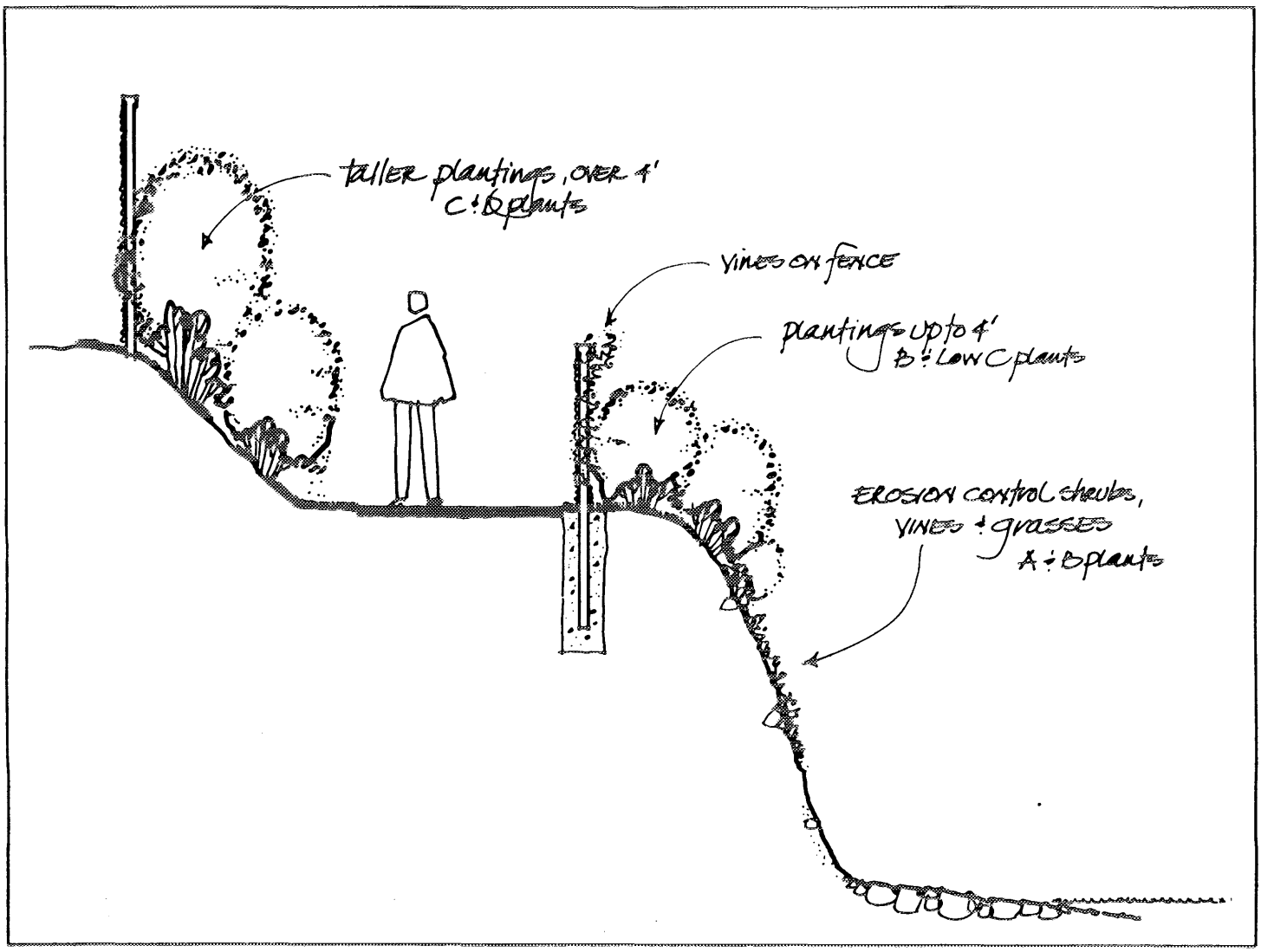
Sketch 1 illustrates several measures which can be employed both to prevent further soil and embankment erosion along the Cliff Walk and to limit public access off the Walk.

Along the landward side of the Walk, larger shrubs (4-10 ft. high) and small trees can be planted in front of existing privately-owned fencing to provide further privacy for homes. (See Type C shrubs and Type D trees on Plant List.)

Fencing, as shown in Sketch 1, should be located in close proximity to the Walk to minimize foot traffic and ensuing damage to vegetation and soil at the edge of the pathway. Screening vegetation such as Halls' Honeysuckle or Virginia Creeper can be used to provide a visually attractive screen for the fencing, and blend it into adjacent plantings.

Shrubs planted on the seaward embankment crest adjacent to the Walk generally should be 4 ft. or less in height so as to provide slope stabilization, yet not restrict scenic views along the Walk (See Type B shrubs in Plant List). Ground cover, vines, and grasses such as Tall Fescue can be planted on steep soil slopes down to rock surfaces or the beach. For seeding and plantings, the slope should first be loamed, fertilized, limed, then seeded or planted. Hydro-seeding is recommended, particularly on steeper or inaccessible slopes. Erosion control fabrics can be used on steep slopes to assist the establishment of vegetation in these fragile areas. This fabric and installation method can help to protect the seeding through periods of water runoff. On more gradual slopes (2:1 or less), matting types which break down over time can be employed. For slopes greater than 2:1, i.e., 1:1 or 1.5:1, permanent fabric that does not decompose is suggested. Hydroseeding with incorporated mulch and takifier -- or sticking agent -- is carried out following the fabric or matting installation suggested in Sketch 6. Seed spread manually or by lightweight spreading machines can be placed prior to fabric installation.

SKETCH 1: A Typical Section of the Cliff Walk



Sketches 2a & 2b: Erosion Control/Guided Public Access: a Drainage Swale/Walkway Combination

Stormwater runoff and lack of proper drainage mechanisms have contributed to the erosion of soil embankments along the Cliff Walk and to erosion of the Walk itself. Frequently, embankment erosion is aggravated by path wear caused by pedestrians wandering off the Walk or leaving the Walk to reach the cliffs and shoreline below -- a practice which can be dangerous.

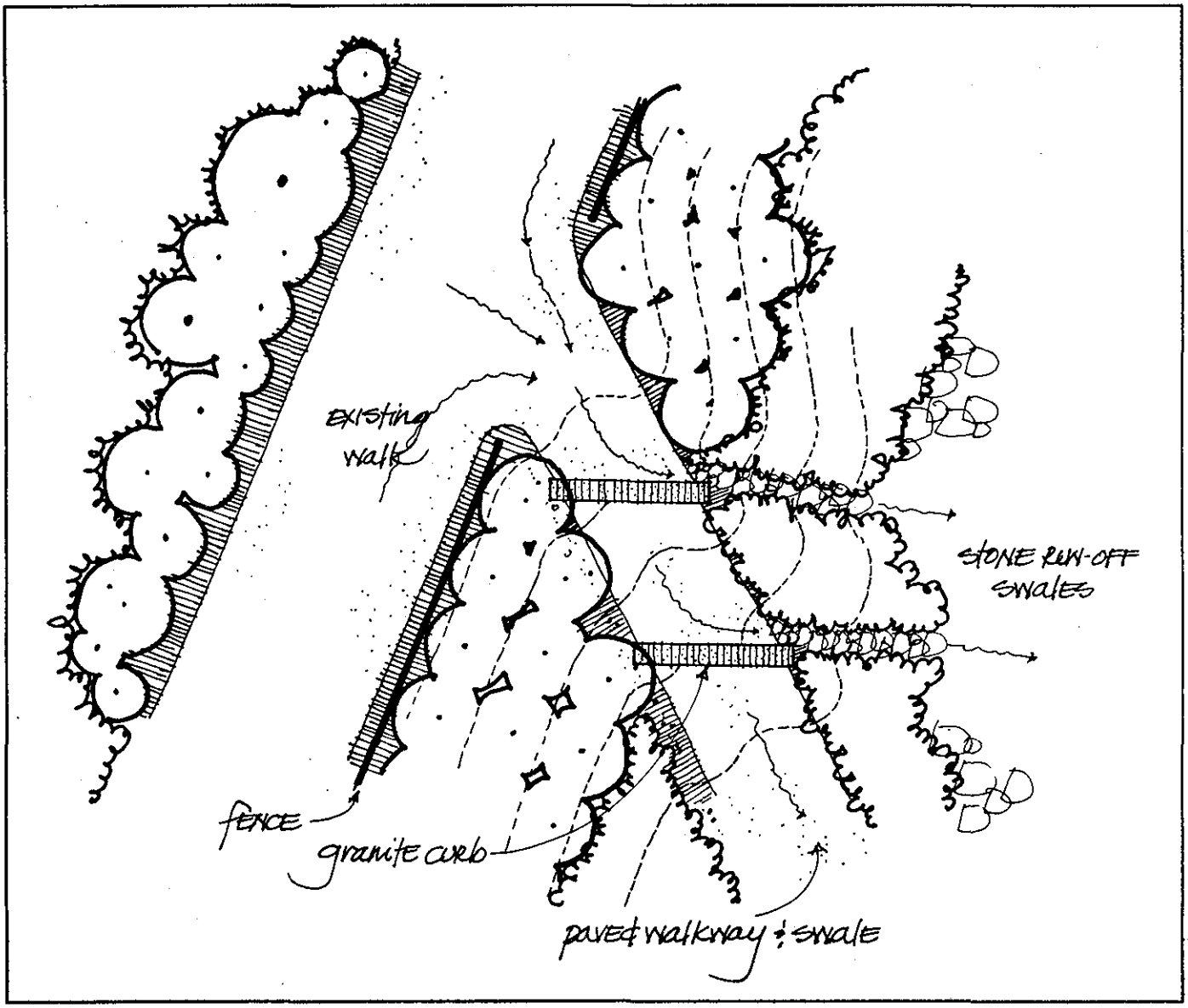
Sketches 2a and 2b present a conceptual design for a drainage swale carrying water off the seaward side of the Cliff Walk. This swale can also be used as a controlled and, hence, safer walkout onto the bluffs or shoreline below. The swale, with a typical width of 3 ft. and a recommended maximum pitch of 2:1, allows pedestrians to walk to and from the lower elevations on a delineated path. Vegetation planted immediately adjacent to the swale/walkway, as illustrated in Sketch 2a, helps ensure that pedestrians remain on the walkway and off the erosion-prone embankments.

The swale sketches suggest that granite curb water bars can be used both to assist in footing as a ramp or step, and also periodically to remove water from the swale. The runoff volume at the bottom of the swale is then reduced; erosion is less likely. To install each of these, a trench should be carefully cut and partially filled with sharp, crushed stone which is compacted so that the curbing will not settle. The granite curbs should be vertical and installed at a cross angle so that the water will pitch off one end.

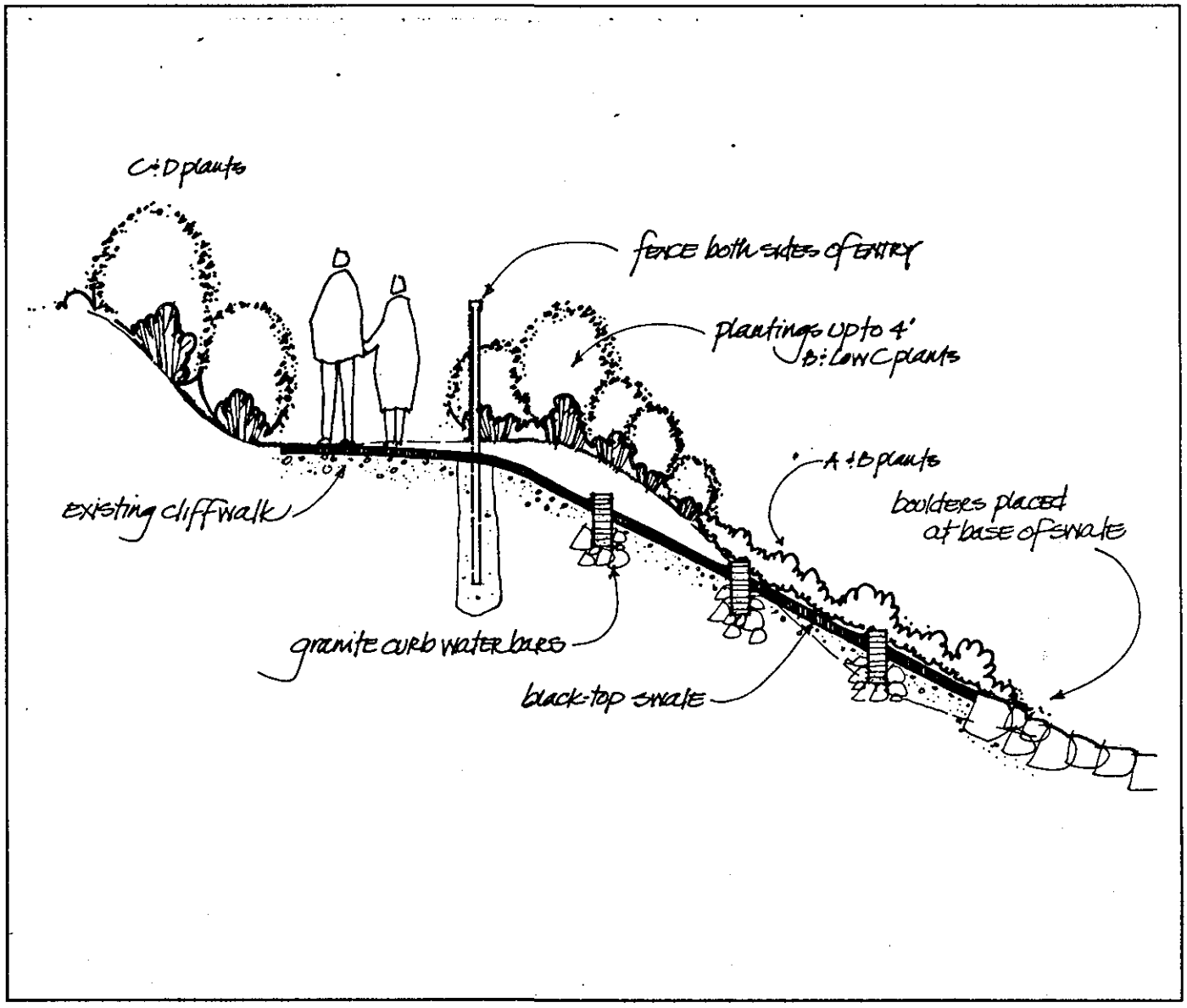
Stones should be placed at each runoff point so that the water flow is carried on a hard surface. It is suggested that overlapped, flat stones be used for this purpose. At the bottom of the drainage swale, a large armorstone should terminate the asphalt swale to prevent erosion. Recommended vegetation along the swale/walkway is Type B (see Plant List), which has dense foliage that helps discourage pedestrians from straying off the walkway and root systems that help stabilize the soil and prevent its erosion. This vegetation should be planted tightly and directly adjacent to the paved swales and walkway to minimize exposed soil and guide pedestrian access.

The installation of a combined drainage swale/walkway system could be employed at specific locations along the Cliff Walk designated by the City of Newport and/or the Cliff Walk Task Force where the creation of a limited walkout for pedestrians is appropriate.

SKETCH 2a: Erosion Control and Guided Public Access- a Drainage Swale and Walkway Combination



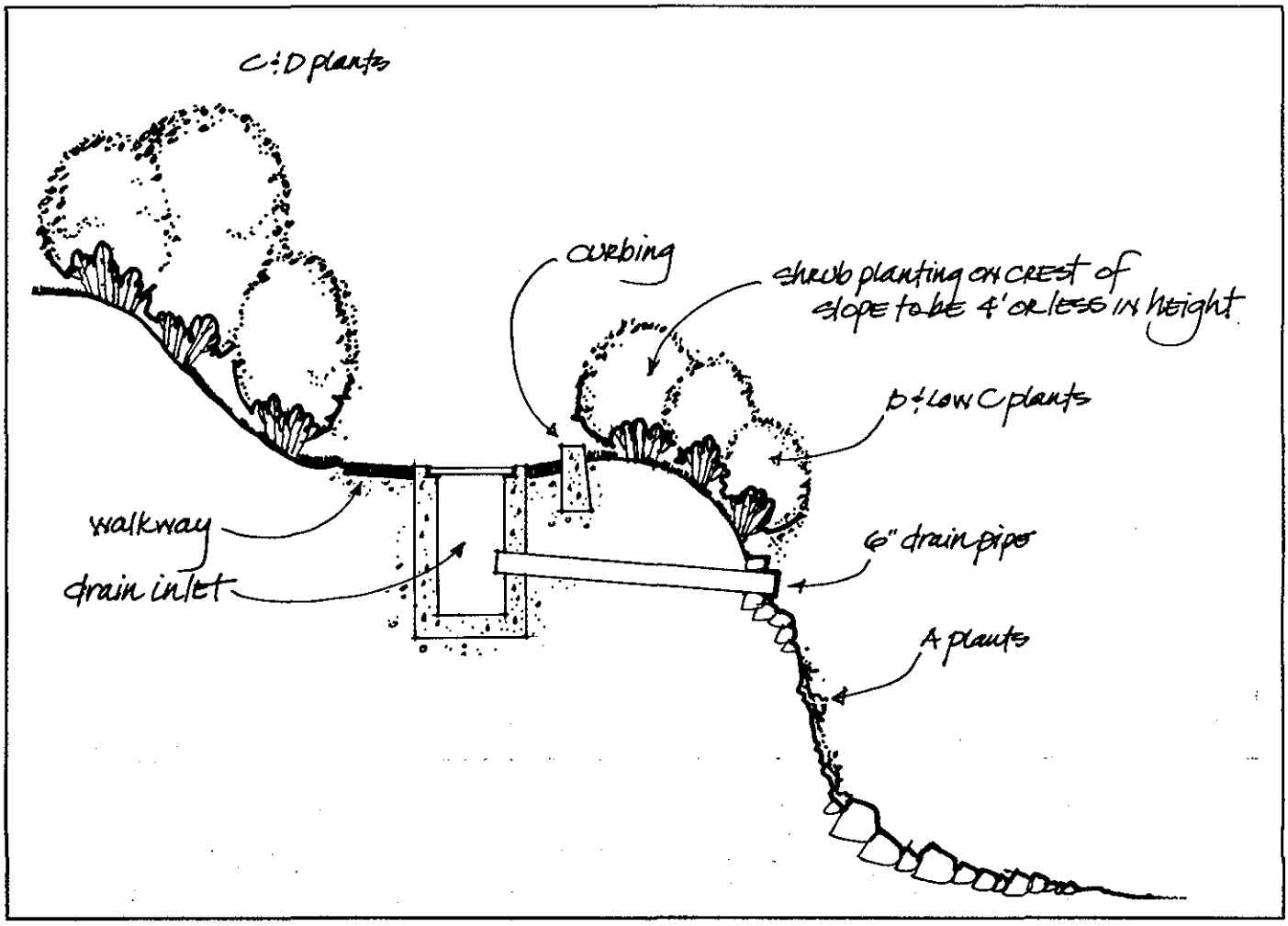
SKETCH 2b (Section): Erosion Control and Guided Public Access- a Drainage Swale and Walkway Combination



Sketch 3: Walkway Drainage and Pedestrian Control

Sketch 3 shows a drainage inlet situated in the path of the Cliff Walk to remove water from the surface without causing edge erosion. Curbing can be used at the side of the Walk to guide water to the drain, and also to encourage people to remain on the paved surfaces rather than damage the vegetation at the Walk's edge. The drain shown in Sketch 3 is approximately 2 ft. in diameter, but a 1 ft. drain could be employed as well. The diameter of the outflow pipe is 6", and can be made of corrugated galvanized metal with an asphalt coating to avoid corrosion. The drain should have a sump to hold solids and reduce the blockage of the outflow. Drain inlet walls can be constructed of reinforced concrete -- pre-cast sections, cast in place, or mortared block. It may be advisable to first locate an appropriate drain cover and bell frame, then design a drain inlet structure to accommodate the frame. The drain cover should be heavy cast iron sufficient to discourage vandalism and should be secured in place either by weight or other methods. The drain cover must be flush with the Walk surface and have narrow drainage perforations so that heels and canes can remain supported. The cover's grid should be perpendicular to the Walk so that bicycle or wheelchair wheels can cross the cover surface easily (although these are not encouraged on the Cliff Walk).

SKETCH 3: Walkway Drainage and Pedestrian Control

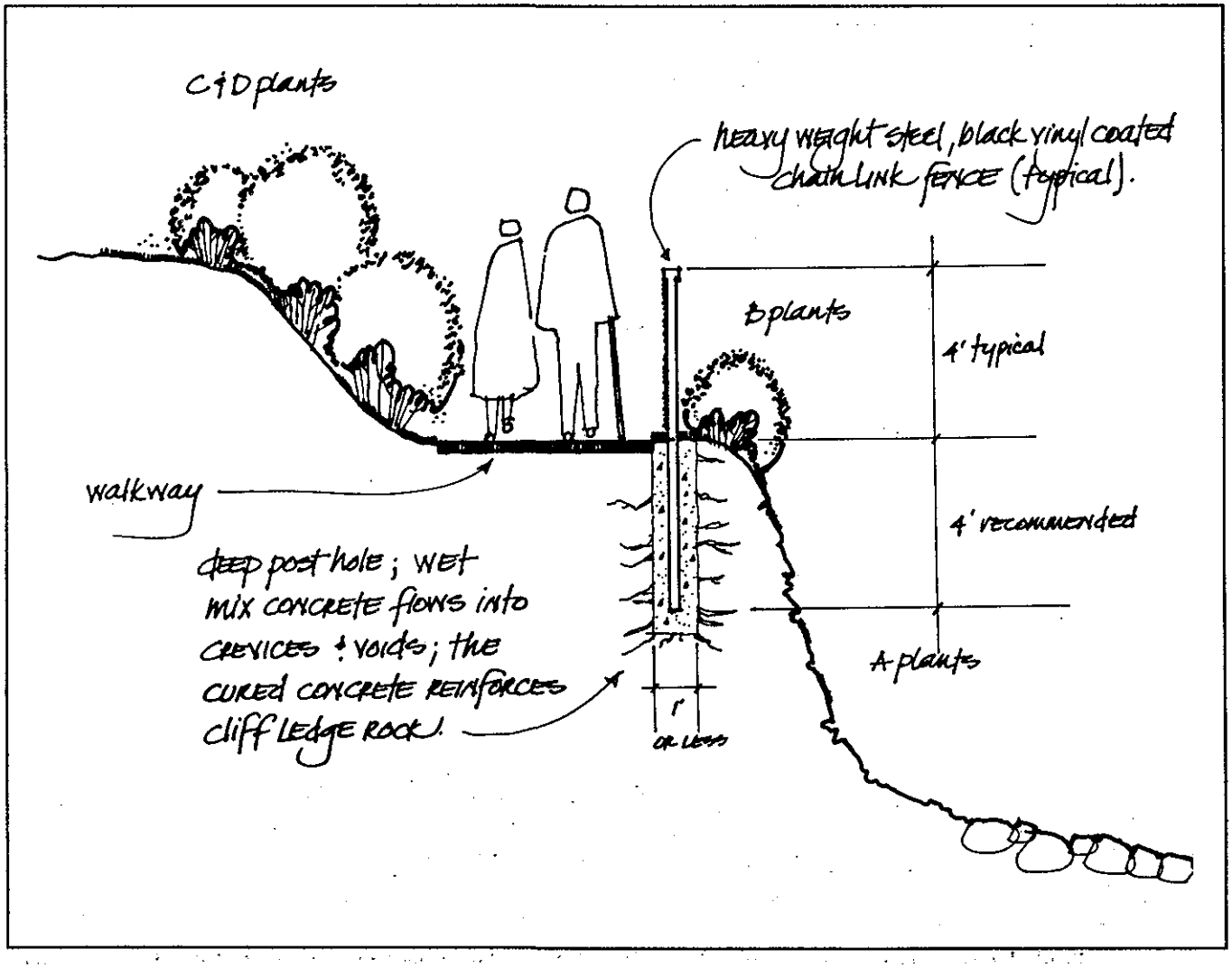


Sketch 4: Fencing Installation at Cliff Edge

Sketch 4 illustrates a suggested installation treatment for fencing at the cliff edge. This can minimize further damage to the fragile cliffs.

It is important to install fence posts at a depth which roughly equals the above ground fence height. This distributes the weight that visitors place upon the fence as they lean against it for viewing. The deep bedding of the posts can also provide further protection against vandalism. Thus, the chance of damaging the cliff rock surface is minimized. The fence post hole (less than 1 ft. in diameter) should be carefully drilled into the soil and rock medium. The posts should be secured using a wet mix concrete that will flow into the crevices of the cliff rock and, when set, will fill these voids and strengthen the base materials.

SKETCH 4: Fence Installation at Cliff Edge



Sketch 5: A Controlled Observation Area

In several sections along the Cliff Walk, pedestrians wandering off the path to admire the view of the sea and mansions have worn down the vegetation on both sides of the Walk. This heavy use has created dirt paths or beaten down areas which in turn have become more susceptible to erosion. Often these "ad hoc" lookout areas are close to precipitous and dangerous embankments. Sketch 5 shows a design treatment for these areas that can provide an aesthetically pleasing viewing area while controlling pedestrian access. The potential for erosion can be greatly reduced through improvements in edging and drainage.

The Sketch shows an 18" wide wall bordering the seaward side of the Cliff Walk that can provide seating for persons wishing to rest. The wall can also guide access off the Walk to the designated steps or gateways. Drainage is provided by scuppers -- slots under the wall -- with a coarse stone swale located under the shrubbery.

A stair is shown providing access to a lower viewing space. Designated areas will minimize erosion by hindering formation of dirt paths. The lower viewing area is surrounded by protective vegetation which also serves to discourage undesirable access off the erodable promontory areas. Along the lower viewing area as well as the seaward side of the Cliff Walk, Type B shrubs are suggested to preserve views while containing visitor observation areas. Appropriately designed signage also could guide pedestrians toward controlled observation spaces and away from hazardous areas.

An additional path paralleling the landward side of the Cliff Walk is shown in Sketch 5 to formally provide a place for viewing mansions without creating more opportunity for erosion.

The walkway surface suggested here is compacted gravel; another alternative is asphalt. While gravel is a more historically authentic material, asphalt may be more efficient for certain heavily traveled areas. The Rhode Island Historical Preservation Commission is investigating an alternative walkway surface to bituminous concrete which is visually compatible with early Cliff Walk gravel and earth surfacing. Their findings may soon recommend a penetrated macadam walk with a rolled stone surface with attention to natural soil colors. "A penetrated macadam walk would consist of a bed of regular asphalt, which is then covered with a layer of liquid asphalt, a rolled layer of graded stone, another layer of liquid asphalt, and a topping layer of rolled fine stone. The stones used should be carefully selected so that in color and appearance they harmonize with the local natural surfaces."[14]

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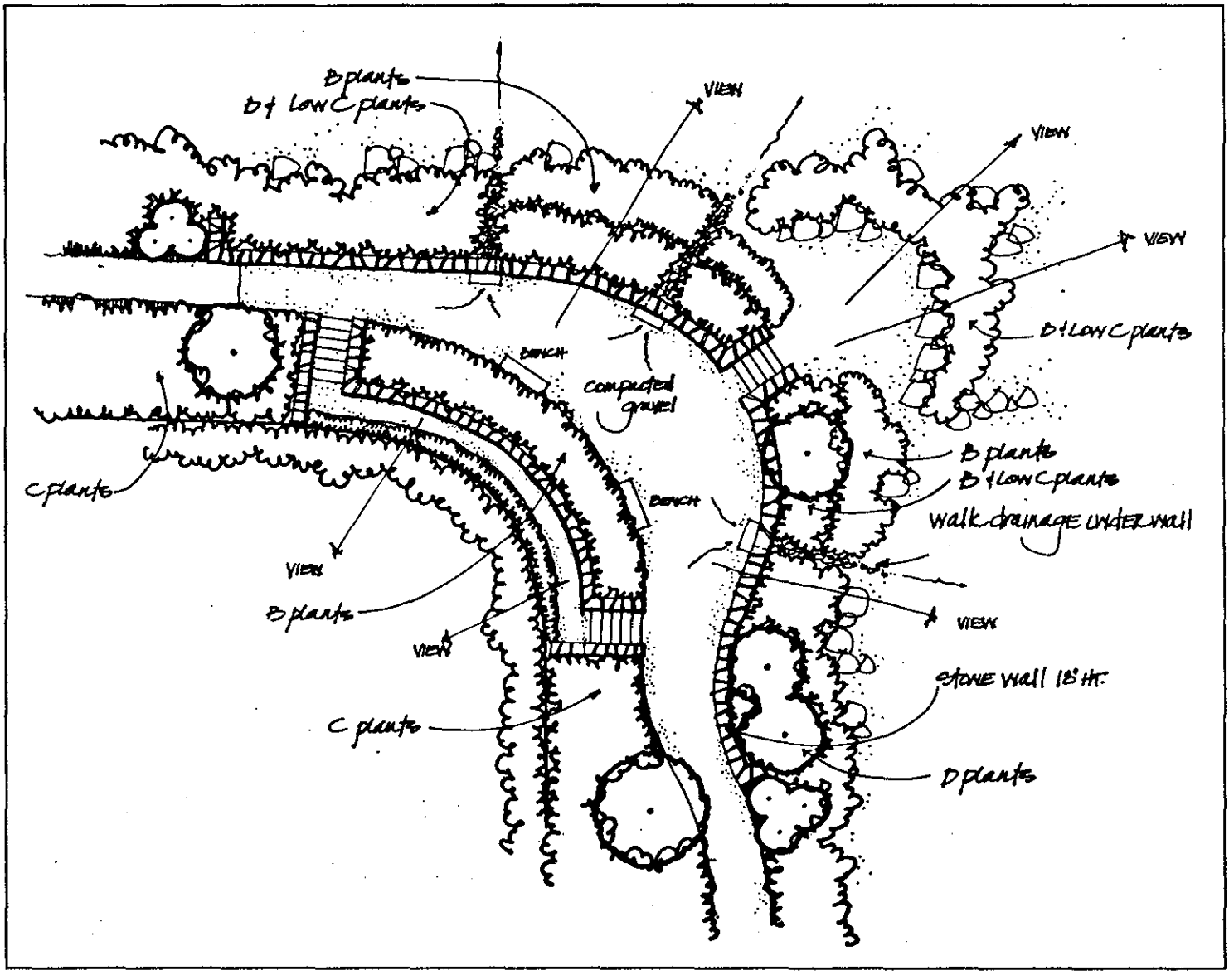
[14] **12/12/91 letter from Rick Greenwood, Rhode Island Historical Preservation Commission, to Sarah James, Federal Emergency Management Agency.**

SKETCH 5: A Controlled Observation Area



Sketch 6: A Rocky Beach Section of the Cliff Walk

In parts of the southern section of the Cliff Walk, the pathway traverses a rocky beach area at the base of eroded soil banks. There is considerable interest in maintaining this section of the Walk as a hiking trail -- instead of a sidewalk -- along the shore. Rocks and boulders scattered across the beach create difficulty for pedestrians, particularly those less physically conditioned due to age or infirmities. While this area does not present the severity of hazards for pedestrians that exist in certain other sections of the Walk nor the immediacy of need for repair -- for example, Site 18[15] -- there are design solutions that could both curtail ongoing beach and embankment erosion and also make the area less difficult for those walking across.

The 1988 Army Corps of Engineers Study Report for the Cliff Walk proposed a stone revetment with a crushed gravel walk for this area.[16] Implementation of this recommendation would protect against future beach erosion, embankment erosion, and provide pedestrians with a safer means of crossing the area. Existing revetments constructed along other sections of the shoreline contain sections of tightly-placed flat armor stone which serve to provide safer footing for pedestrians traversing the revetments. A revetment solution for this area would endure more over time and require less maintenance. It would be more expensive, however, and also would change the area's character as a natural beach.

Sketch 6 depicts an alternative solution which retains the area's character as a flat beach. Such a solution is more consistent with the goal to preserve diverse walking experiences along the Cliff Walk. It also suggests hazard mitigation opportunuties at a lower level of physical improvement and alteration.

Pedestrian movement across the beach could be improved by building a meandering stepping stone walkway with larger flat-sided stone, similar to armor stone but which could be smaller in size. Excess boulders removed from the path right-of-way can be placed at the base of the slope to further protect the soil from future wave-wash. Angular boulders with interlocking capacity are preferred for boulder rows. Additional backfill should be placed behind the boulder rows. Grasses and vines can then be planted on the new fill to minimize erosion.

The landward embankment along the southern section of the Cliff Walk was severely scoured by waves during the recent storms. It is recommended that erosion control measures be

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[15] See Section E on page 16 of this report.

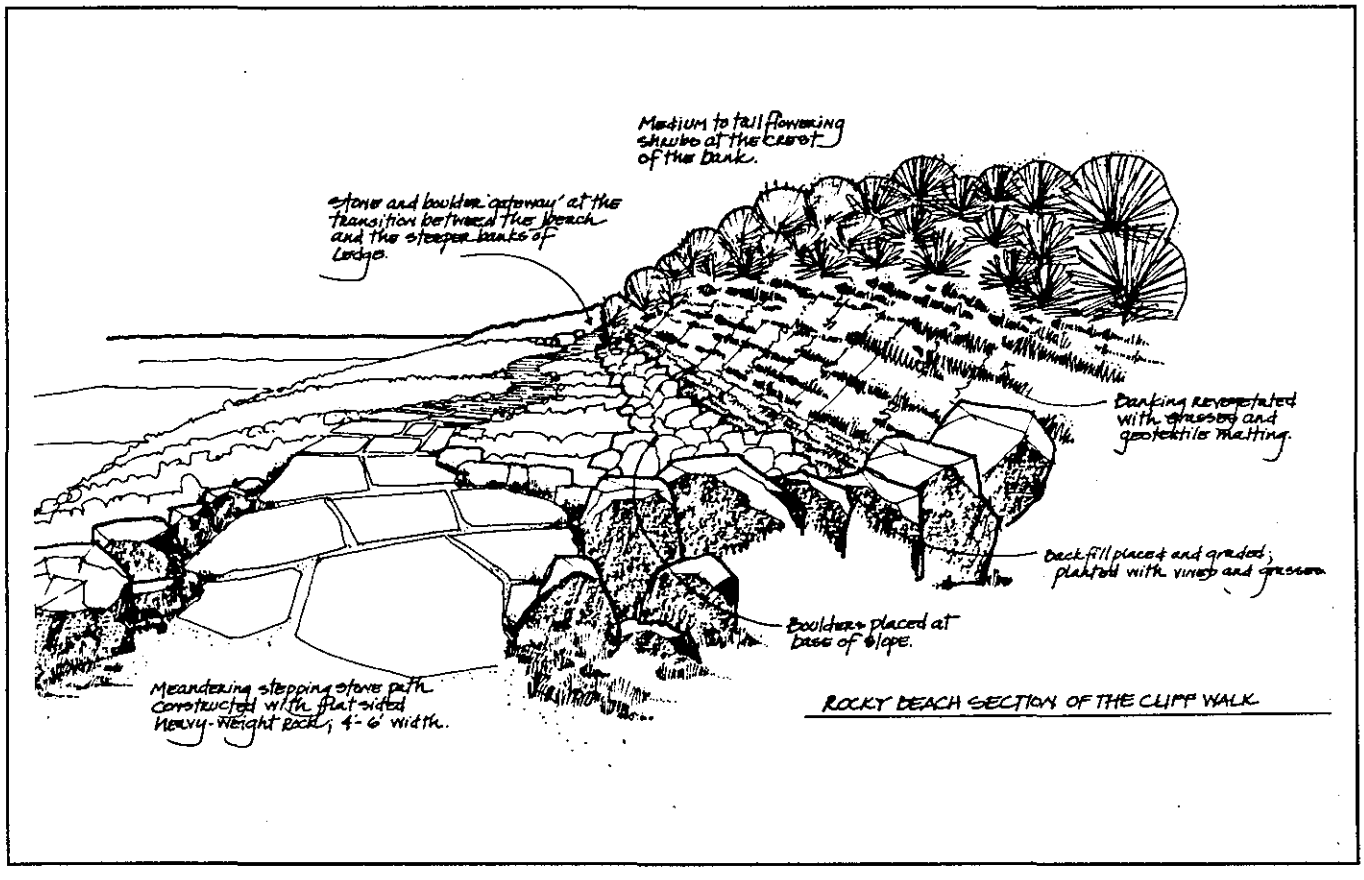
[16] See the following maps in the 1988 ACE Report: a) General Plan 2, Plate 6, Reach 5; b) Plan 17, Plate 24, Section ZZ; and c) Plan 18, Plate 25, #28, #29, #30. (Copies also in the Appendix of this report.)

applied immediately to secure the bare slopes. This should include loaming, seeding, and the installation of blankets or matting to encourage revegetation while stabilizing the embankment soils. As illustrated in Sketch 6, medium height and taller shrubs can be planted at the crest of the slope for visual interest and to form an appealing edge to the beach environment. The plantings should be carefully placed so as not to block important views from nearby residences.

At either end of the beach stepping stone path, a modest "gateway" to the next areas could be suggested by placing several large boulders adjacent to the walkway. These "gateways" would provide visible orientation points for walkers crossing the rocky beach.

After major storms, stone debris and gravel likely will accumulate on the flat stone walkway. Periodical cleaning of this walkway section should be a permanent part of an ongoing maintenance program for the Cliff Walk.

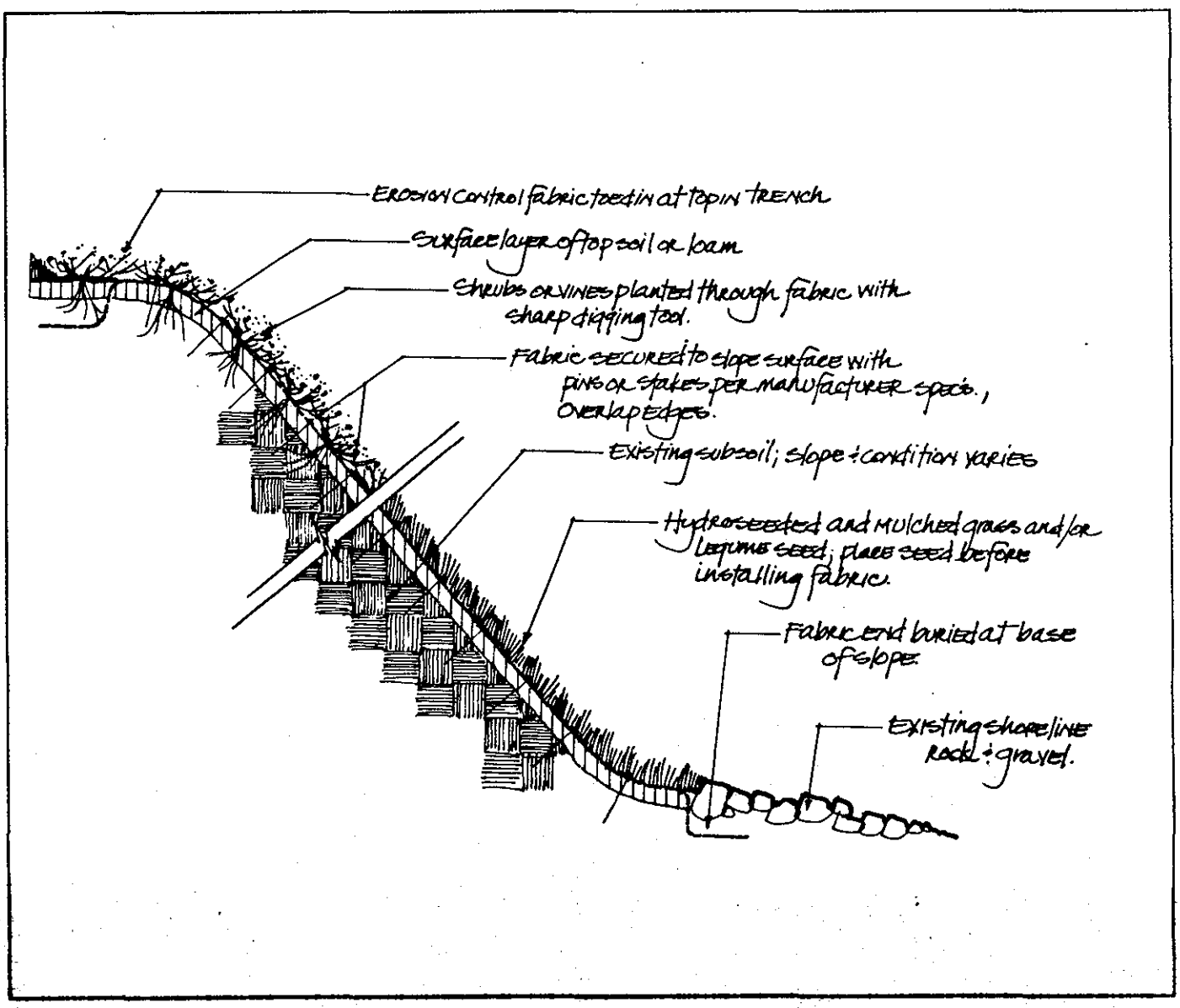
SKETCH 6: A Rocky Beach Section of the Cliff Walk



Sketch 7: Matting & Planting Techniques for Steep Slopes

Sketch 7 shows a technique for stabilizing slopes through the use of an erosion control fabric and hydro-seeding. The drawing depicts an embankment with grass and shrub plantings. The illustrated technique is appropriate for the steeper slopes adjacent to the Cliff Walk where soil or fine gravel can support vegetation. The top and bottom of the fabric or mat should be anchored in trenches while the fabric on the slopes should be secured with metal pins or stakes. The material should be placed in overlapping lengths running perpendicular to the contours of the slope. Erosion control materials and fasteners can be selected to break down over time if a permanent structural element is not desired.

SKETCH 7: Matting and Planting Techniques for Steep Slopes



TYPES OF FABRIC, MATS, AND BLANKETS COMMERCIALLY AVAILABLE FOR EROSION CONTROL

1) WOVEN JUTE
   - Biodegradable
   - Absorbs water

2) EXCELSIOR (WOOD FIBER) BLANKET WITH PLASTIC NETTING; three weights for varying slope severity
   - Biodegradable
   - Photo degradable
   - Absorbs water

3) STRAW BLANKET WITH PLASTIC NETTING
   - Biodegradable
   - Photo degradable
   - Absorbs water

4) COCONUT FIBER BLANKET WITH PLASTIC NETTING
   - Biodegradable
   - Photo degradable
   - Absorbs water

5) NYLON FIBER (FINE TEXTURE), THREE-DIMENSIONAL MAT SEWN WITH PERMANENT THREAD
   - Non-degradable

6) NYLON MONOFILAMENT (COARSE TEXTURE) FUSED INTO A THREE-DIMENSIONAL MAT
   - Non-degradable

7) POLYVINYLCHLORIDE, BONDED INTO A THREE-DIMENSIONAL MAT; two weights for varying slope severity
   - Nondegradable

IV. SUMMARY

The Cliff Walk is experiencing structural damage and erosion caused primarily by wave action and storm water runoff. Undesirable pedestrian access off the Walk presents both safety hazards to pedestrians and further destabilization of fragile slopes and vegetation.

Methods for erosion control along the Cliff Walk include:

- Structural improvements such as riprap and armorstone, reconstruction of footings and retaining walls
- An ongoing monitoring and maintenance program of man-made structures, embankment and vegetation conditions
- Revegetation of worn Walk edges and embankments
- Fencing, curbing, and planting to guide pedestrian access, preserve vegetative cover, and prevent soil erosion
- Swales and drain inlets for removal of storm water

The structural improvements, landscape restoration, and maintenance recommendations contained in this report are presented to interested individuals, agencies and organizations to support their efforts in preserving the Cliff Walk and other fragile coastal areas. Appropriate hazard mitigation actions can help maintain the integrity of the Cliff Walk and other coastal paths for the enjoyment of future generations.

APPENDIX

LOCATION MAP: SITE 10

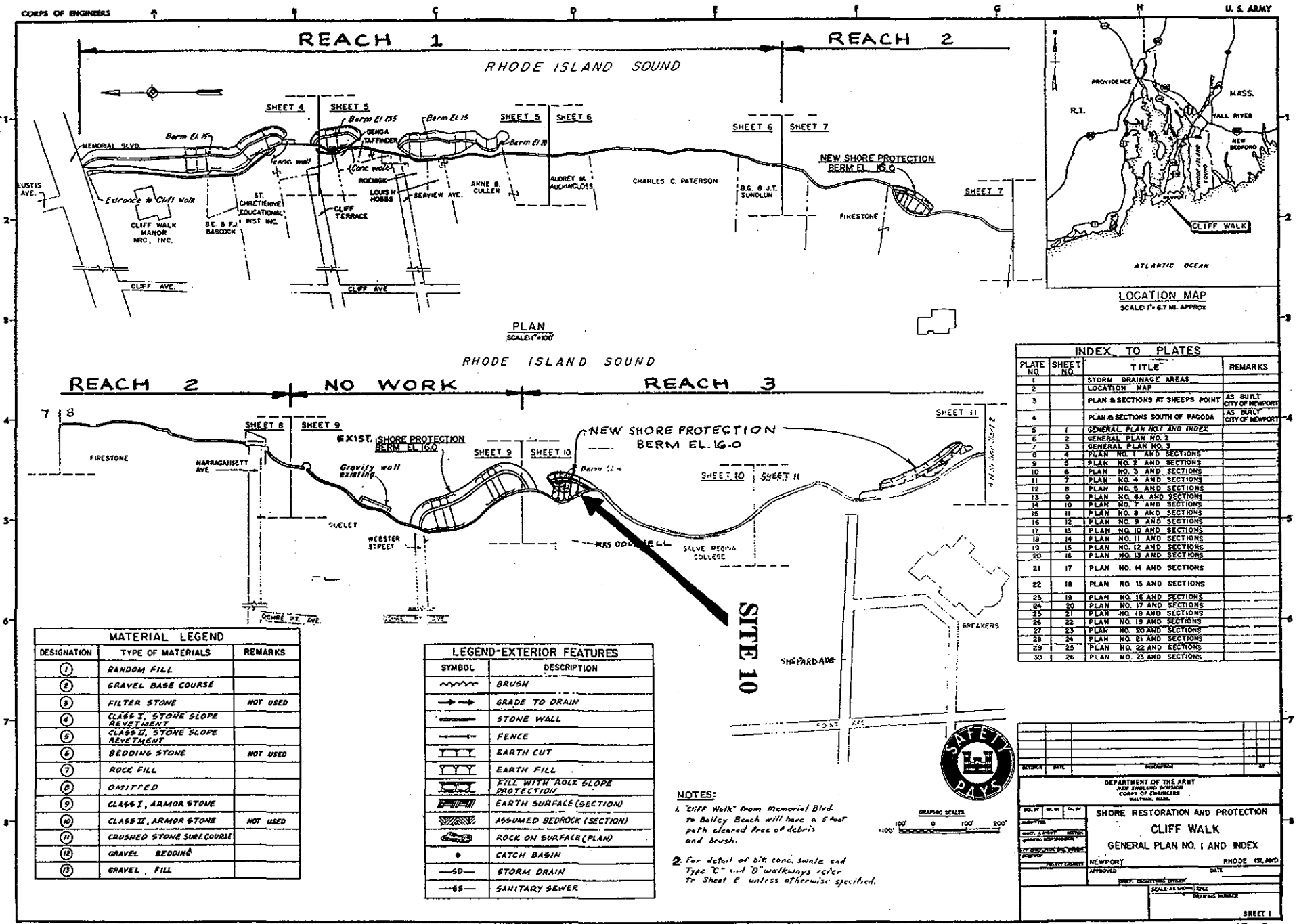
LOCATION MAP: SITE 7

LOCATION MAP: SITE 11a
SITE 12a

LOCATION MAP: GENERAL PLAN 2

LOCATION MAP: GENERAL PLAN 17

LOCATION MAP: GENERAL PLAN 18



INDEX TO PLATES

PLATE NO.	SHEET NO.	TITLE	REMARKS
1		STORM DRAINAGE AREAS	
2		LOCATION MAP	
3		PLAN & SECTIONS AT SHEEPS POINT	AS BUILT CITY OF NEWPORT
4		PLAN & SECTIONS SOUTH OF PAGODA	AS BUILT CITY OF NEWPORT
5	1	GENERAL PLAN NO.1 AND INDEX	
6	2	GENERAL PLAN NO. 2	
7	3	GENERAL PLAN NO. 3	
8	4	PLAN NO. 1 AND SECTIONS	
9	5	PLAN NO. 2 AND SECTIONS	
10	6	PLAN NO. 3 AND SECTIONS	
11	7	PLAN NO. 4 AND SECTIONS	
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21	17	PLAN NO. 14 AND SECTIONS	
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26	22	PLAN NO. 19 AND SECTIONS	
27	23	PLAN NO. 20 AND SECTIONS	
28	24	PLAN NO. 21 AND SECTIONS	
29	25	PLAN NO. 22 AND SECTIONS	
30	26	PLAN NO. 23 AND SECTIONS	

MATERIAL LEGEND

DESIGNATION	TYPE OF MATERIALS	REMARKS
(1)	RANDOM FILL	
(2)	GRAVEL BASE COURSE	
(3)	FILTER STONE	NOT USED
(4)	CLASS I, STONE SLOPE REVETMENT	
(5)	CLASS II, STONE SLOPE REVETMENT	
(6)	BEDDING STONE	NOT USED
(7)	ROCK FILL	
(8)	OMITTED	
(9)	CLASS I, ARMOR STONE	
(10)	CLASS II, ARMOR STONE	NOT USED
(11)	CRUSHED STONE SURF. COURSE	
(12)	GRAVEL BEDDING	
(13)	GRAVEL FILL	

LEGEND-EXTERIOR FEATURES

SYMBOL	DESCRIPTION
	BRUSH
	GRADE TO DRAIN
	STONE WALL
	FENCE
	EARTH CUT
	EARTH FILL
	FILL WITH ROCK SLOPE PROTECTION
	EARTH SURFACE (SECTION)
	ASSUMED BEDROCK (SECTION)
	ROCK ON SURFACE (PLAN)
•	CATCH BASIN
—SD—	STORM DRAIN
—65—	SANITARY SEWER

NOTES:

1. "Cliff Walk" from Memorial Blvd. to Bailey Beach will have a 5 foot path cleared free of debris and brush.
2. For detail of bit. conc. swale and Type "C" and "D" walkways refer to Sheet 6 unless otherwise specified.

SAFETY PAYS

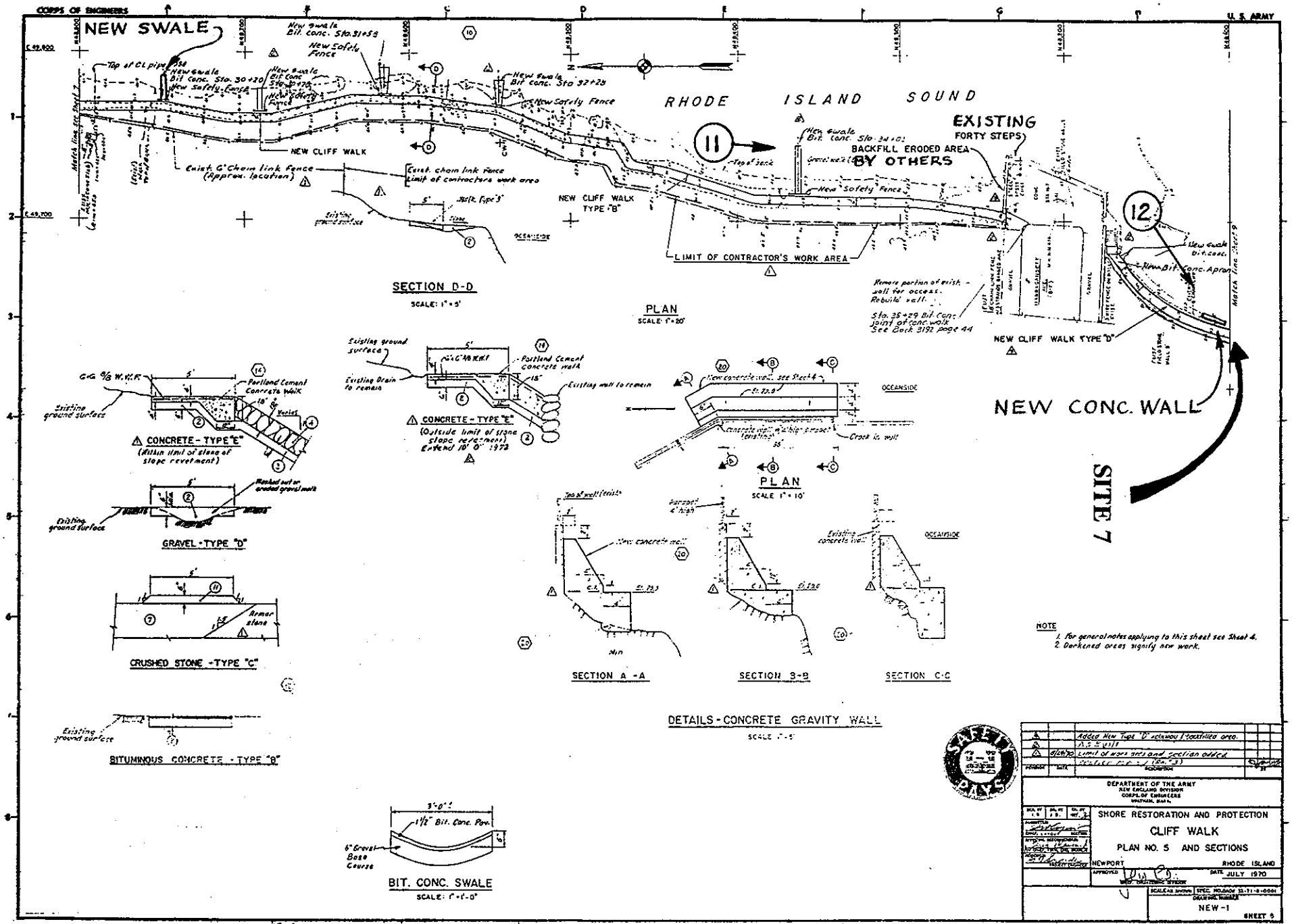
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

SHORE RESTORATION AND PROTECTION
CLIFF WALK
GENERAL PLAN NO. 1 AND INDEX
NEWPORT RHODE ISLAND
APPROVED DATE
SCALE: AS SHOWN
SHEET 1

PLATE 5

LOCATION MAP: Site 10

(Plate 5, 1988 ACOE Study)



LOCATION MAP: Site 7

(Plate 12, 1988 ACOE Study)

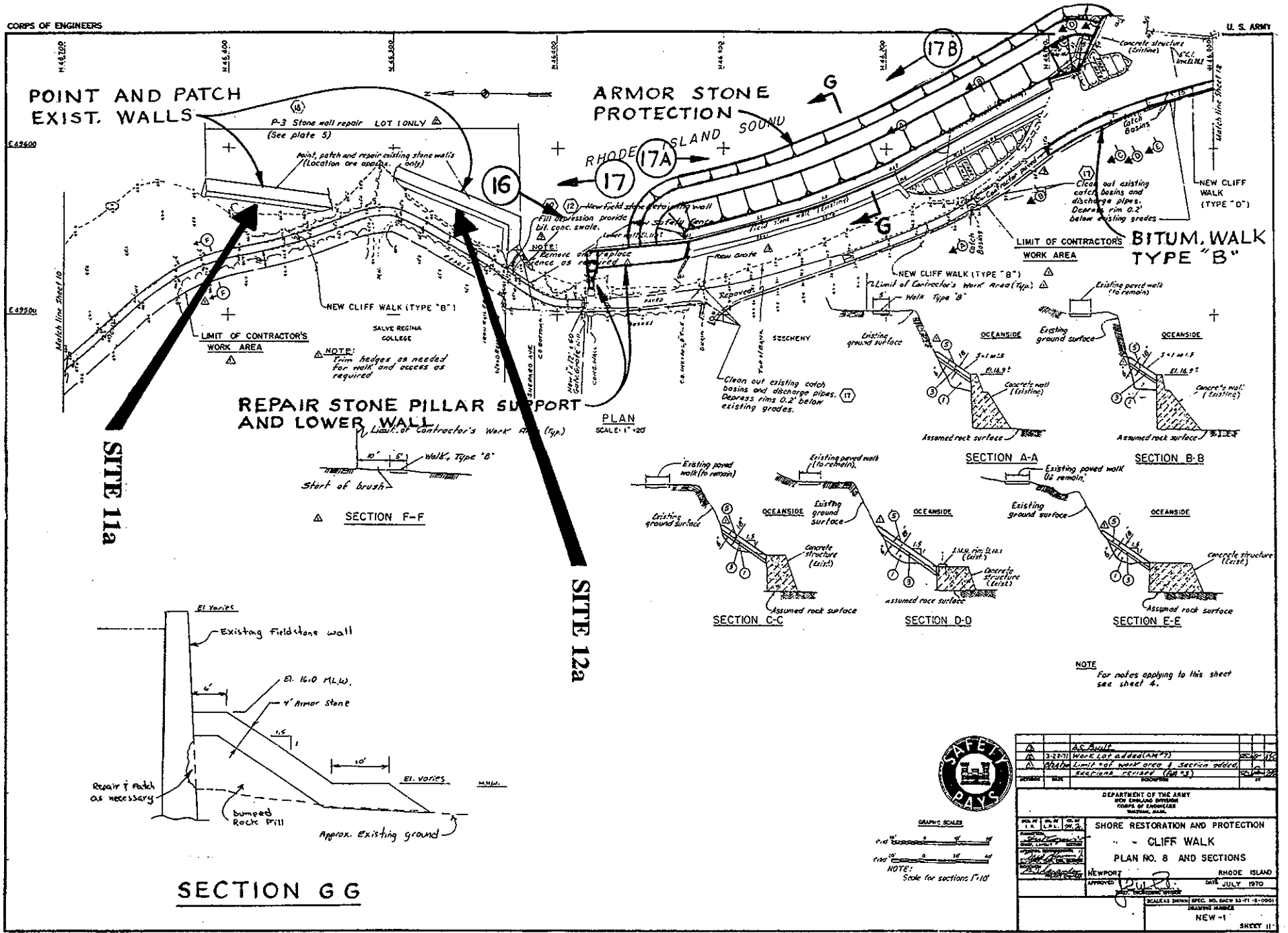


PLATE 15

LOCATION MAP: Site 11a and 12a

(Plate 15, 1988 ACOE Study)

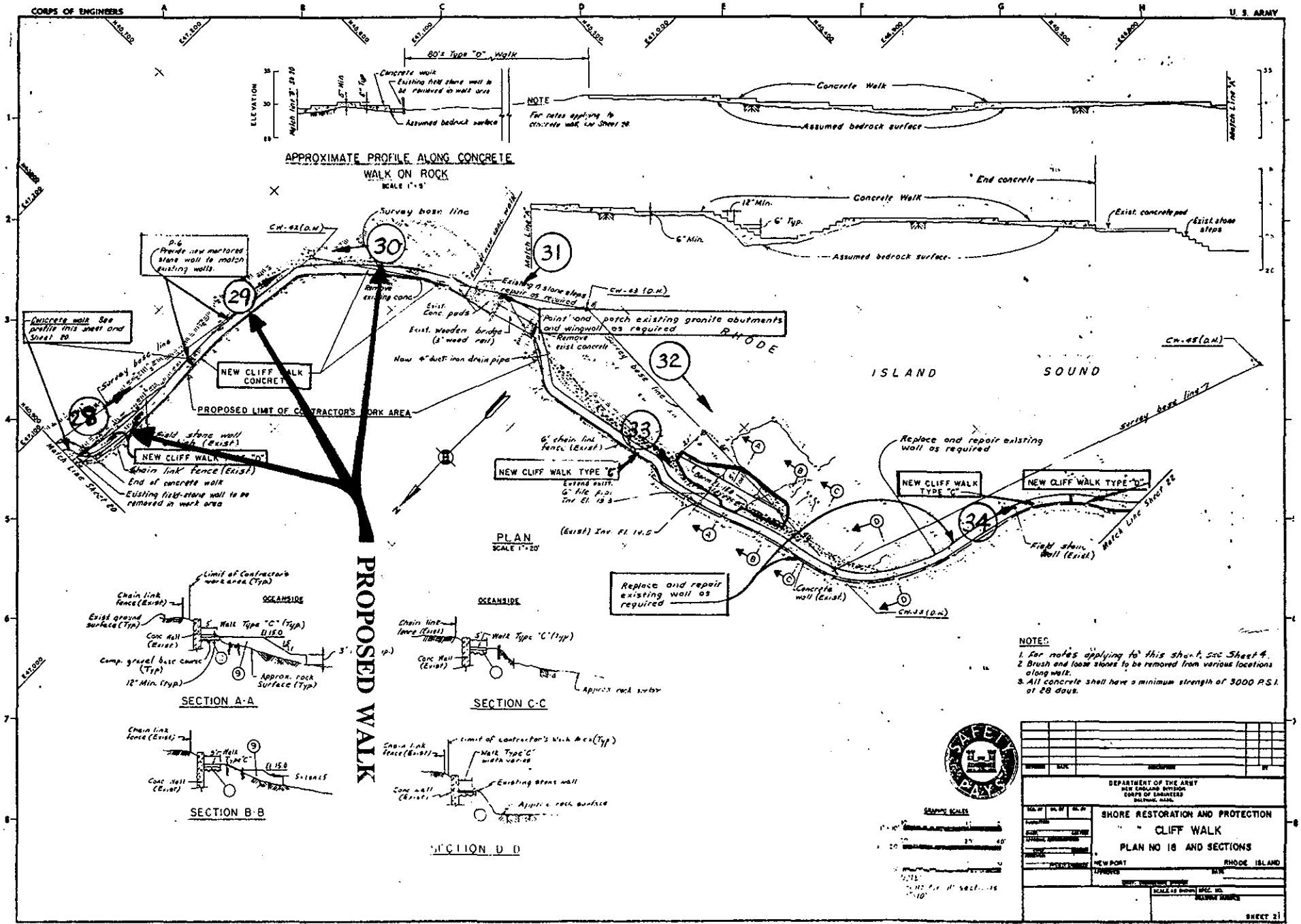


PLATE 25

LOCATION MAP: General Plan 18

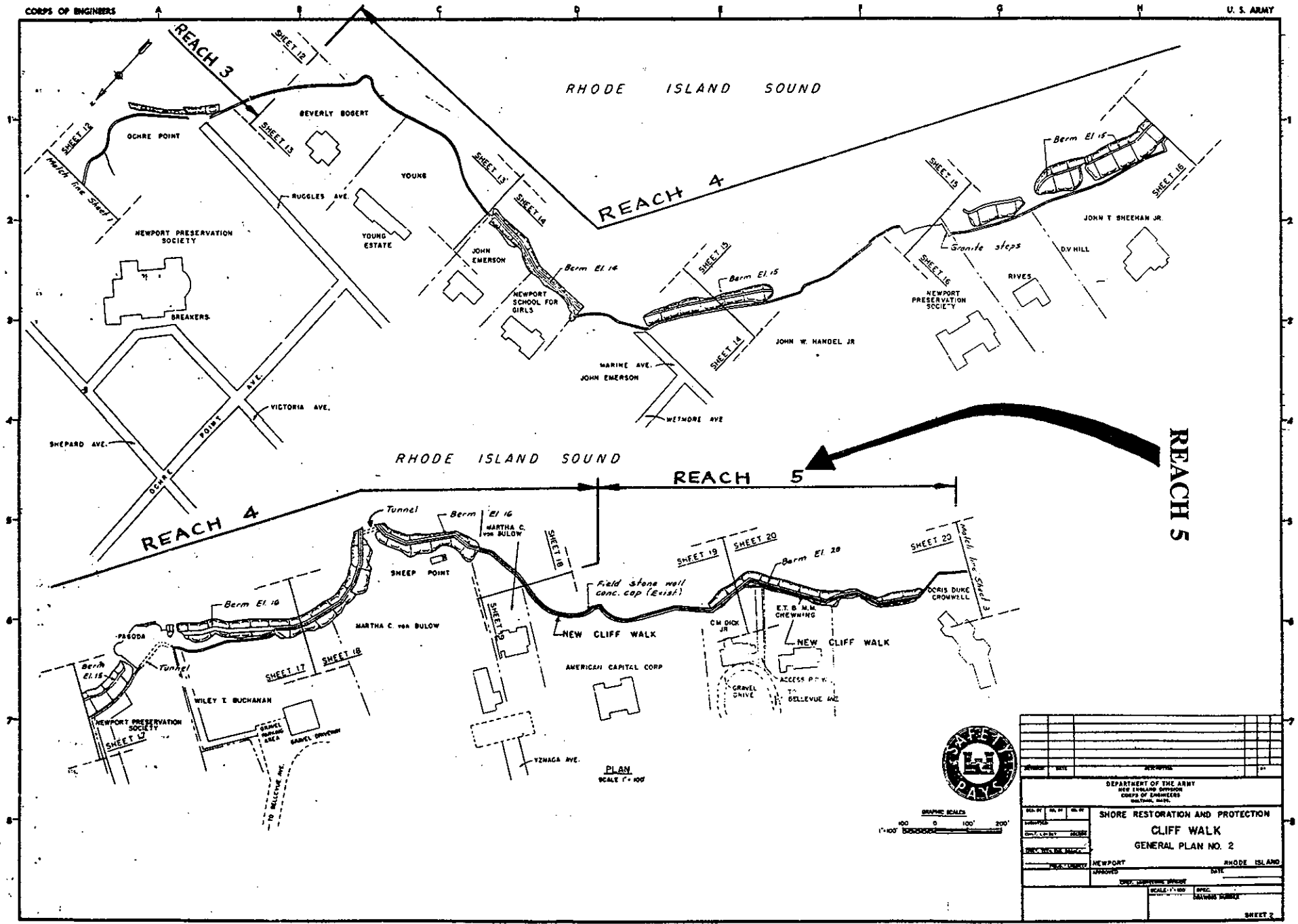
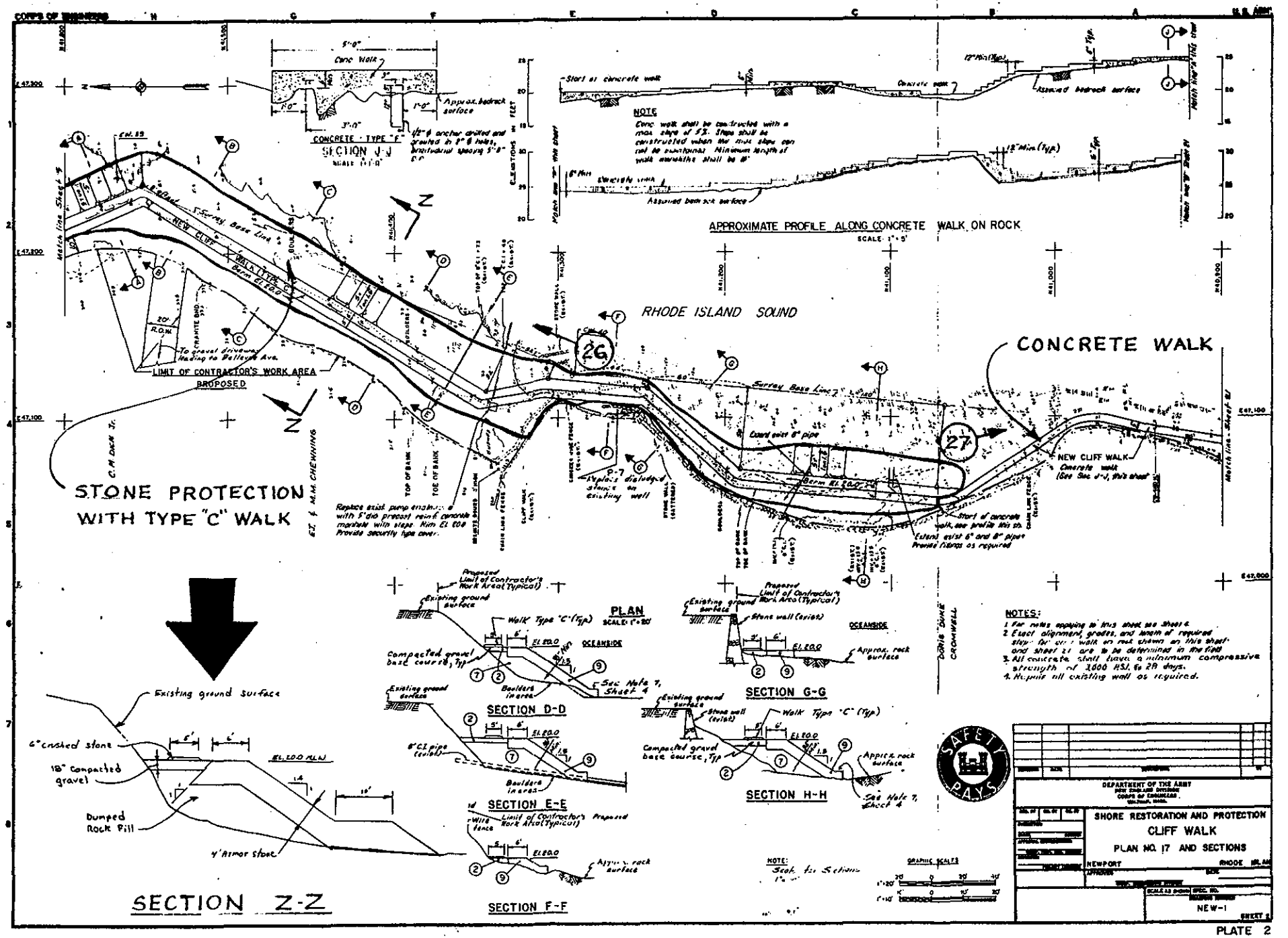


PLATE 6

LOCATION MAP: General Plan 2



LOCATION MAP: General Plan 17

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Information concerning erosion control fabrics, mats, and blankets was provided by:

Mirati Incorporated, Charlotte, North Carolina
North American Green, Evansville, Indiana
PPS Packaging Company, Fowler, California
Reemay Incorporated, Old Hickory, Tennessee
Webtec Incorporated, Charlotte, North Carolina

Information was also provided by the following individuals and sources:

Theodore Kelsey, Soil Conservation Service, Durham, NH 11/29/91.
Christopher Miller, Soil Conservation Service, National Technical Center, Cape May, NJ. 11/4/91.
Holly Kenyon, Soil Conservation Service, Middletown, RI. 11/6/91.
Maggie Hogan, "Plant Clinic," Department of Plant Science, University of Rhode Island, Kingston, RI. 10/10/91.
Peggy Eyeth, Cliff Walk Society. (Provided Cliff Walk Plant List.) 9/91.
Silvan Nurseries, Westport, MA. 11/25/91.
Arnold Arboretum Plant Information Line, Boston, MA. 11/25/91.

SOURCES OF ASSISTANCE

Coastal Resources Management Council of Rhode Island

Rhode Island Historical Preservation Commission

University of Rhode Island Plant Science Department

U.S.D.A. Soil Conservation Service

U.S. Army Corps of Engineers